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Original Articles

SERIAL STUDY OF GOOD OCCLUSION FROM BIRTH TO 12 YEARS OF AGE

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Occlusion is constantly changing. How and when these changes take place needs further exploration. Although the literature has considerable information on the measurement of the dental arches, this supplies us with only general ideas which serve as steppingstones. By making a detailed study of the individual growth and developmental pattern from birth onward, we may obtain a clearer concept of how the individual arch develops. For this purpose I have selected from my group of 60 white children two males and two females. Each had a varied dental history with a common end result, good occlusion. These four healthy children have been followed continuously from birth to 12 years of age. At no time did any of them receive appliance therapy.

The points of measurement have varied with each investigator. However, this problem has never been undertaken on a serial basis from birth onward. It was therefore necessary to devise a method of measurement suitable to my study. Measuring of casts, particularly serial casts, offers a great challenge. What points can be traced from birth through maturity? I will present a minimum number of dimensions which indicate the quantitative and qualitative aspects of the dental arches from birth to 12 years. Points of measurement are anatomic, or defined as precisely as possible. All we may expect from any point is to be within acceptable limits so that it may serve a useful purpose to an applied science. (The average error of measurement was 0.4 mm. with a range in error of from 0.1 mm. to 0.5 mm.)

The orthodontist has pioneered in research on the relationship of the dentition to the face and head. In order to achieve a better understanding of the relationship of the dentition to its surrounding structures four points (Fig. 1) were selected for measurement. These are represented by the Roman numerals

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I, II, III, and IV. Between these points twelve measurements (Fig. 2) were taken for the maxillary and mandibular dental arches, respectively. In addition a rugae dimension, R, was also taken which will be discussed later. These points are described in detail together with a discussion of some anatomic developmental landmarks which are helpful in orthodontic diagnosis.

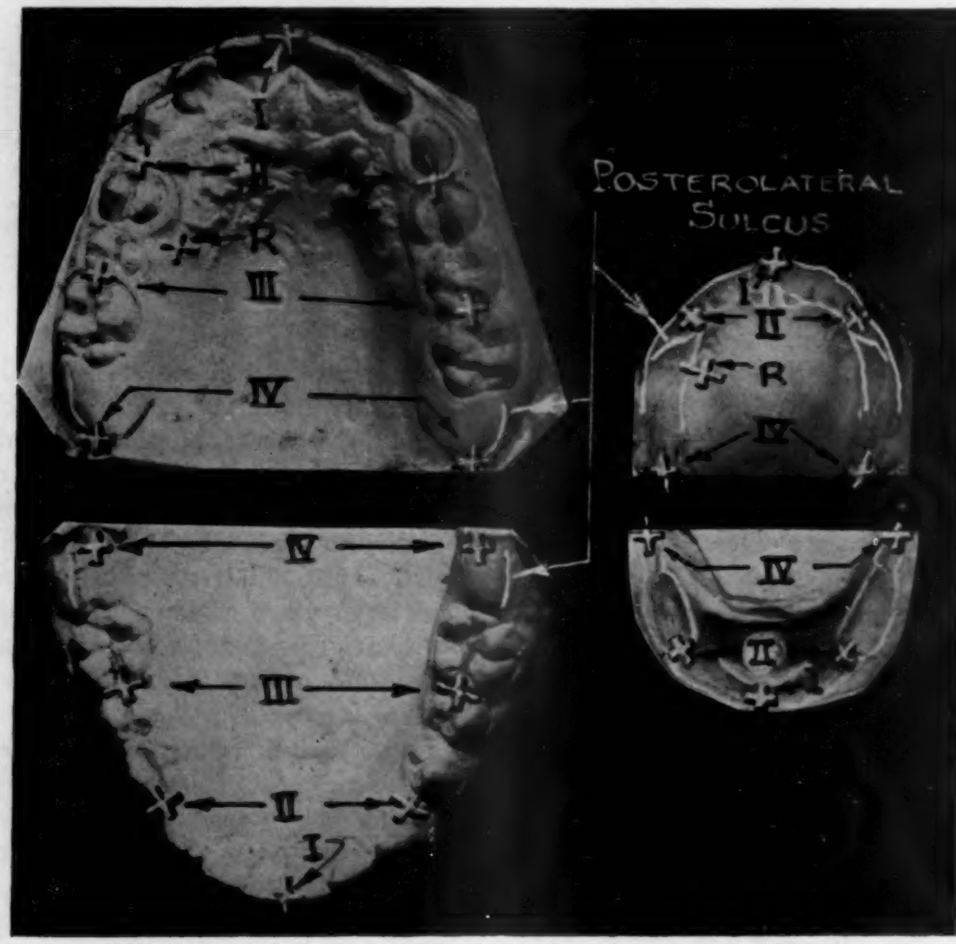


Fig. 1.—Occlusal view of casts at birth and 12 years of age illustrating points of measurement. At birth there is no Point III. Note the position of the posterolateral sulcus at birth and at 12.

Point I.—In the maxillary edentulous infant's arch (Fig. 3) this point is located by the intersection of the sagittal plane with the everted edge. This edge is always present in the maxillary and mandibular arches, being more prominent in the latter. A remnant of these everted edges can be traced as the child develops. In the mandibular edentulous arch the median line is drawn between the median notches of the dental groove and the everted edge. The mid-point of this line is Point I. As the dentition unfolds, this point is always located by a line drawn through the center of the first incisal edges intersecting the median line.

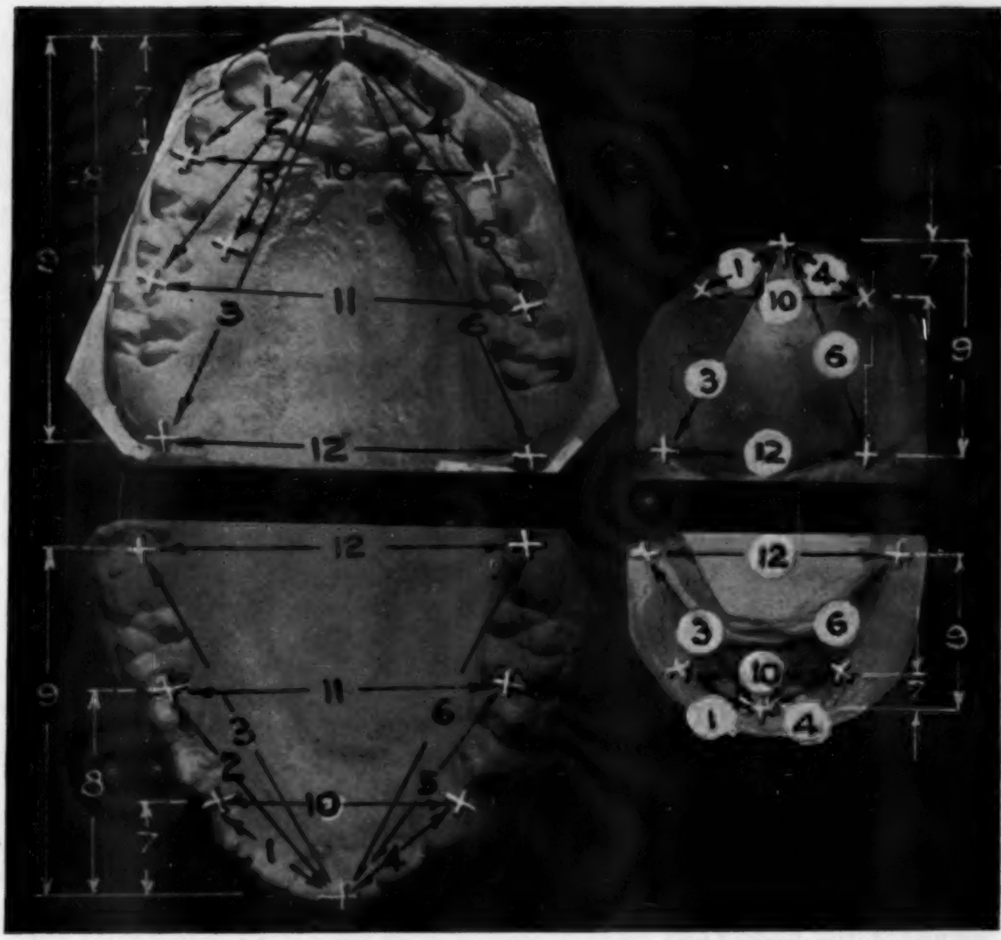


Fig. 2.—Occlusal view of casts at birth and 12 years of age illustrating the measurements taken. Dimension R at birth is not shown, and dimensions 2 and 5 not taken.

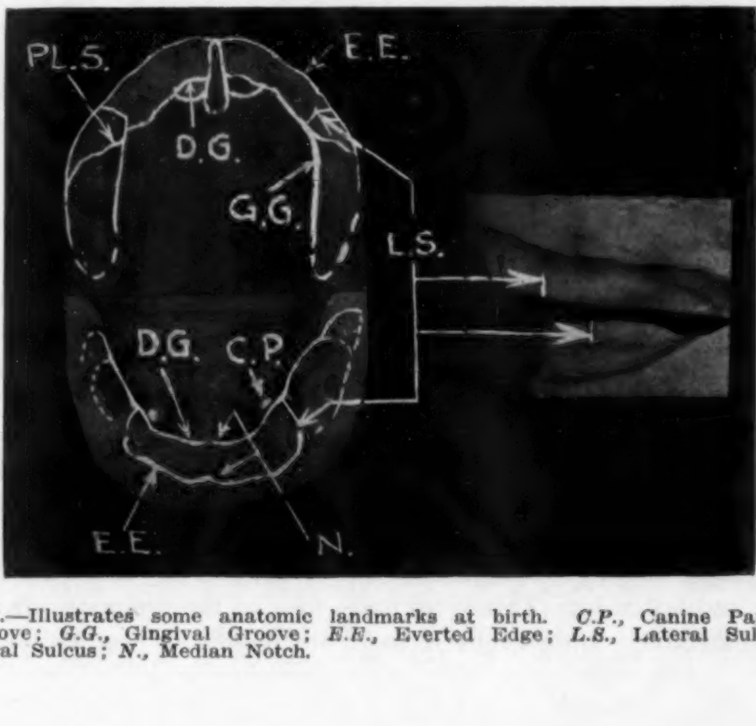


Fig. 3.—Illustrates some anatomic landmarks at birth. *C.P.*, Canine Papilla; *D.G.*, Dental Groove; *G.G.*, Gingival Groove; *E.E.*, Everted Edge; *L.S.*, Lateral Sulcus; *PL.S.*, Posterolateral Sulcus; *N.*, Median Notch.

Point II.—In the edentulous infant, this point is located by the intersection of the lateral sulcus with the crest of the gum pad. In the maxilla the lateral sulcus is well defined, starting at the linguogingival groove, crossing the gum pads to the labial, and terminating in the lateral frenum. In the mandibular arch the lateral sulcus can be seen on the lingual aspect only. The approximation of the lateral sulcus on the labial aspect may be judged by the lateral frenum. At times its location on the lingual aspect may be slightly obscure, but one may then be guided by the canine papilla, which is mesial to the lateral sulcus. This papilla appears throughout the series, but changes in morphology. It is clinically valuable, for it establishes the relationship of the canine to an anatomic developmental landmark apart from the dentition but related to it, and is helpful in diagnosis. With the eruption of the dentition, the lateral sulcus becomes the interdental papilla. In order to locate Point II with consistent accuracy the relationship must be noted between the mid-point of the distal border of the canine and the mesial groove of the first deciduous molar, or first premolar, as the case may be.

Point III.—This point cannot be determined in the edentulous infant. It is first located at the distal groove of the second deciduous molar. In order to locate this point during changing dentition, its relationship to the first permanent molar must be noted.

Point IV.—This point is the posterior limit of the dental arches. In the maxillary arch during infancy this point is not distinct, because the gum pads in the region are very shallow. However, as a guide you have the gingival groove on the buccal and lingual aspects, plus the pterygomandibular raphe, which is slightly lingual to Point IV but in a different plane. Point IV is located by a line drawn on the crest of the gum pad to its most posterior limit. As the arch matures, the tuberosity becomes more distinct, and the posterolateral sulcus, which was present at birth, also becomes well defined. The posterolateral sulcus which serves as a guide to locate Point IV normally follows the general arch form. When it does not, it may indicate that a malformation is present in this region. Such a conclusion cannot be drawn from a single observation. Malocclusion is a malformation, and a distortion of this landmark is an expression of an existing malformation in a specific area. This anatomic developmental landmark should be tested by your experience and evaluated clinically. In the edentulous mandibular arch the extreme limit of the molor gum pad is well differentiated, and therefore Point IV is located by a line passing across the crest to the posterior limit of the gum pad. As the dentition appears, the posterolateral sulcus becomes markedly defined and more prominent than in the maxilla, so once again there is a guide for locating Point IV.

Between these four points (Fig. 1), twelve measurements (Fig. 2) were taken for each of the dental arches. This means approximately 300 measurements for each child. (All measurements are given in millimeters and read to the nearest tenth.) Dimensions 1 to 6 are vector dimensions, taken on the right and left sides. This gives us an idea of the symmetry or asymmetry of the dental arch. Dimensions 10 to 12 are widths. These vector and width

dimensions are relatively easy to obtain by use of a vernier caliper. The measuring of the length dimensions 7 to 9 presented a problem. My procedure was evolved by trial and error and the following was found to be simple and satisfactory. A steel ruler was placed between Points II and II and held securely. Then one end of the vernier caliper was placed on Point I, while the other end was placed at the mid-point on the steel ruler between Points II and II, thus giving the anterior length of the arch (dimension 7). A similar procedure was used for the posterior length (dimension 8) and the total length (dimension 9).

TABLE I. DIMENSIONS OF MAXILLA (ROGER)

	RIGHT SIDE			LEFT SIDE			LENGTH			WIDTH			
AGE	1	2	3	4	5	6	7	8	9	10	11	12	R
3 da.	13		29.4	13		29	7.2		26.5	23.6		23.1	16
4 mo.	16		31.4	16.4		32	8		28	27.3		30	19.5
1-1	16.8		34.4	17.2		34	9		30.8	28.5		31	20.8
1-11	19		39	18.4		38.8	11.1		35	30		32	22
3-6	18.6	33	40	19.4	33.7	39	12	27.5	36	30.6	38	34	23
4-1	19	33	40	19	33.7	39.8	11.5	28.2	36	31	38	34.4	23
5-10	18	33	42	19	33.4	43.5	10.8	27.4	38.5	30.8	40.4	37.5	22.8
7	19.5	34	44.4	20.8	35	45.6	12.4	28	41	32.5	41.6	41	24.4
7-8-23	21.4	35	47.8	22	35.8	48.8	13.5	28.5	43.4	34.5	42	41.8	26
8-8-23	21.8	35.8	48.7	22	36	48.8	14	29	45	34	43	43	27
9-6	22	36	49.5	22.4	36	49	14	29	45.6	34	43.5	44	27
10-5	22.6	36.5	50	22.8	36.8	50	14.8	29.5	46	34.3	44.2	44	28.5
11-5	22.3	37.2	52.3	22	36.2	51.5	13.7	29.4	47.5	34.5	44.1	45	28.6
12-0-19	22.4	36	52	23.9	37.5	53	15.8	30.7	48.5	34.7	44	45.5	28.8

TABLE II. DIMENSIONS OF MAXILLA (SKIPPY)

	RIGHT SIDE			LEFT SIDE			LENGTH			WIDTH			
AGE	1	2	3	4	5	6	7	8	9	10	11	12	R
10 da.	13.7		29.3	13.7		29.2	6.7		26	22.5		24.8	15.5
1-2-14	18.7		37.2	18.5		38.5	12		33.8	28.6		32	22.6
2-5-11	19.5		39.2	19.7		39.8	13		36	30.5		32.4	23
2-11-10	19.8	34.7	41	19.8	33.8	39.6	13	29	36.8	31	37	34.5	23.2
4-7-10	20	34	41	20	33.4	40.4	11.8	28	37	31	37.5	36	22.6
5-10	19.4	33.7	42	19	33.2	42.8	11	27	38	30.6	39	37	23
8-5	22.3	35.6	50	22	36	50	12.8	29.7	45	34.3	40.2	41	25
9-6	23	37.8	52	22.4	36.8	53.2	15	31	48.6	34.6	40.5	42.4	27.3
10-6-9	24	36.8	52.5	22.5	36.3	54.8	15.2	31	50	34.2	41	42.4	28.1
11-6-9	24.5	36	54	22.7	36.2	55.6	16	29.8	50	34.1	41.2	43	28.5
12-6	24	36.4	56	23	36.8	56	16	30	53	34.7	42.6	43.8	28

TABLE III. DIMENSIONS OF MAXILLA (BARBARA)

	RIGHT SIDE			LEFT SIDE			LENGTH			WIDTH			
AGE	1	2	3	4	5	6	7	8	9	10	11	12	R
6 da.	13.5		27	15		25.8	7.2		21.6	25.4		25.8	15.7
1-1-27	17.2		35.7	18		35.7	11		31.5	27.5		31.5	21.3
1-5-12	18.7		36.5	19		38.5	12		33.6	29.6		32.6	21.7
2-0-25	19		38	19.2		37.8	12		33.8	28.7		32.2	22.5
4-2-10	19.5	33	41	19.2	33.5	41	12	26	36.7	30	38	35.8	21.8
7-3-6	19.2	32	43	19	32.8	45	12	26	40.2	31.4	40.4	38.5	22.3
8-10-7	20.9	34.8	47.3	21.4	35	46.7	13.7	27.2	43.4	32.5	40.8	40	25.2
10-1-28	22.4	33.5	47.6	21.6	35.3	49.8	14	27.3	44.2	32.6	41.5	42	26.5
11-1-1	21.7	34	50	22.8	35.5	52.2	14.4	28	46.6	33.1	42.8	43.5	27
12-0-28	21.8	33.5	49.5	21.9	35.5	50.6	13.6	27	47	34	42.5	45	27.5

TABLE IV. DIMENSIONS OF MAXILLA (MARIE)

	RIGHT SIDE			LEFT SIDE			LENGTH			WIDTH			
AGE	1	2	3	4	5	6	7	8	9	10	11	12	R
3 da.	14		28	14.2		28.2	7		24.2	25		27	16.5
5 mo.	16		33.4	16.8		34.2	8.4		30.5	28		30.5	19
1 yr.	18.8		36.9	17.5		35.4	10		33	30.4		32.7	20.5
1-8	19.7		38.2	19.1		39.8	12		34.2	30.4		34	21.8
2	19.5		39.6	20		38.4	12.4		35	30.7		34.5	21
3-8	18.8	32.6	40.2	19.5	33.6	41	12	27	36.4	31.2	40	36.5	20.5
5-3	18.2	32.7	42	19.4	33.6	42.6	11.2	26.5	37	31	40.5	37	21
6-7	19	33.6	46.5	19	34	46.8	11.4	27	41.5	31	40.4	41	22
7-8	20.8	34	47.4	19	34.2	47	11.7	27.5	42.8	31.5	40.6	41.5	23
8-8	21.4	35.8	50.8	19	35	49.5	12	29	45.7	31.6	40.7	42.7	25.7
9-7	21.8	36.8	51.7	20	35	51	13	28.5	46.2	32	41.8	43	27
10-6	22.2	35	54.4	21	35.5	53	14	28.5	48.4	32	41.7	45	27.8
11-9-16	22.2	35	55	20.6	36.3	53.3	13.4	29	49	32.5	41.4	46	28

Curves were plotted for the four children from the accompanying tables (Tables I to VIII). If we look at all the curves 1 to 8 which contain dimensions 1 to 6, we will note a certain degree of asymmetry for all the dental arches,

TABLE V. DIMENSIONS OF MANDIBLE (ROGER)

	RIGHT SIDE			LEFT SIDE			LENGTH			WIDTH		
AGE	1	2	3	4	5	6	7	8	9	10	11	12
3 da.	10		22	10		23.2	5		18	18.4		28.4
4 mo.	13		27	13		28.4	6		21.5	24.2		34.6
1-1	13		34.5	13		34	7		29.6	24		34.2
1-11	15		37.8	14		38	8		33.3	25		37.5
3-6	15	29.6	39.5	14.8	29.5	39.3	8.3	24	34.8	25	34	37
4-1	15	29.8	40.1	14.5	29.4	39.8	8.4	24	35.4	25	34.5	38
5-10	15	29	41.9	14.7	30	40	8	23.4	36.9	26	36	41.5
7	16.7	30.2	43.2	15.4	30	41	8.8	24.4	38	27.8	37.5	43.7
7-8-23	16	30.6	43.5	16.4	31.2	43.3	9	24.4	38	28	38	44.5
8-8-23	17.2	31.4	44.7	16.3	31.5	44.3	9	24.5	38.4	28.2	39	45
9-6	17	31.4	46	16.8	32	46	9	24.5	40	28.2	39	47.4
10-5	16.4	31.7	47.2	16.7	32	47.4	9	25.2	41	28.3	39.2	47.8
11-5	18	31.5	48.4	17.8	32	48.4	10.2	25.5	42.5	28.8	39.8	47.8
12-0-19	17.8	31.5	49.5	17.9	32	49	10.7	26	42.7	28.5	39.6	47.4

which, of course, is universal in biology. Roger's maxillary curves (Fig. 4) showed asymmetry. Although the sum total of the mesiodistal diameters of his maxillary permanent teeth (right and left sides) is identical, there are differences of dimension in individual teeth. The maxillary left incisor is

TABLE VI. DIMENSIONS OF MANDIBLE (SKIPPY)

	RIGHT SIDE			LEFT SIDE			LENGTH			WIDTH		
AGE	1	2	3	4	5	6	7	8	9	10	11	12
10 da.	12		23.3	10.7		22.8	5		17.7	20.8		30.8
1-2-14	15.6		30	13.4		28.8	6.4		25	23.5		33
2-5-11	14	29.2	37.6	14	29	36.8	7.8	24.6	32.2	23.4	31.5	37
2-11-10	13.8	28.8	37.7	14.2	29	37.6	7.2	24.3	32.5	24	32	37.2
4-7-10	14	29	39	13.8	28.4	38.5	7.4	23.7	34	23.9	32.6	37.6
5-10	13.8	29.1	41.4	15	29.4	41	6	23	35.2	24	35	39
8-5	17.4	27.7	43.9	15	28.8	44.2	7.2	23	37.9	27	34.8	45
9-6	17.1	27.4	45.4	15.5	30	46	9	23	38.7	26	34.9	45
10-6-9	16	28	46.5	16	30.7	47.7	9	24.3	40	26.8	34.7	45.6
11-6-9	17	29	50.5	18.4	30	49	9.5	23.5	44	28.5	35.8	46
12-6	17.3	29.2	53.1	18.2	30	54	9.5	24	47.4	28.3	35.4	47.2

TABLE VII. DIMENSIONS OF THE MANDIBLE (BARBARA)

	RIGHT SIDE			LEFT SIDE			LENGTH			WIDTH		
AGE	1	2	3	4	5	6	7	8	9	10	11	12
6 da.	12.4		22.3	12.2		22.3	5.5		17.2	18.8		28.6
1-1-27	14		31.6	13.6		31.6	7		26.1	24.5		34.8
1-5-12	14.4		32.7	14.8		33.5	7.4		28	24.5		36
2-0-25	13.5	28	34.4	13.6	28	36.6	7.2	23.2	30.6	22.7	33	37
4-2-10	14.4	28.8	35.7	14.4	29.6	35.8	7	23.9	30.5	23.7	34.5	38
7-3-6	13.9	28	41.8	14.4	27.7	41.9	7	22	36	25	35.7	40.8
8-10-7	15.2	29	42.6	16.2	28.6	43	7.5	23	36.4	26.4	36	43
10-1-28	16	31	41	16.5	32	44.2	10	24.2	36.5	25.8	39.5	45
11-1-1	16.9	32	46.8	16.8	32.5	45.4	10	24.6	39.5	27	39.9	46
12-0-28	16.9	31.8	47.4	17.2	32.5	48	10	25	41	27.2	40.6	47.3

0.4 mm. greater than its mate. Another point worth stating is that a slight buccal version of the maxillary left permanent molar was present since its eruption and is maintained throughout the series. Perhaps this may explain the degree of asymmetry. Roger's mandibular curves, however, are relatively symmetrical (Fig. 4).

TABLE VIII. DIMENSIONS OF MANDIBLE (MARIE)

	RIGHT SIDE			LEFT SIDE			LENGTH			WIDTH		
AGE	1	2	3	4	5	6	7	8	9	10	11	12
3 da.	12.8		23	12		23.4	6		17	23		30
5 mo.	13.3		28.3	13.2		28.5	6.6		23.6	24.4		33.8
1 yr.	13.5		30.6	14		30.5	5		23.8	25.5		36.5
1-8	13.5		32.6	14		31	5.5		24.4	25		38.5
2	14.6	29.4	34.2	14.3		33	7.5		27	24.4		38
3-8	15	30	38	14.5	29	37	8	23.5	31.8	24	34.5	41
5-3	15	30	40	14.3	30	39.5	8.5	24	33.8	24	34.7	41.4
6-7	15	29	44.2	14.8	30.5	45.5	9	24	38	24.2	35	45
7-8	15.8	29.8	43.5	15	27.8	43.5	9.2	23.4	37	25.2	34	44.8
8-8	16	27	44.8	16	29.7	45	9.8	22.6	38.5	25.5	34	45.6
9-7	15.8	27.8	45.8	16.4	30.3	46	9.8	23.3	39	24	35	46
10-6	17	29	49.5	17.6	29.9	47.2	11	24.5	41.7	26.2	34.6	47.8
11-9-16	16.4	28.7	50.2	17.4	31.3	51.6	10.5	23.4	44	25.6	35.5	47.6

Skippy's curves for dimensions 1 to 6 (Fig. 6) showed a remarkable degree of symmetry considering that he lost his mandibular right first deciduous molar (Fig. 7) prior to his eighth year. The mesiodistal diameter of this tooth (Table X) was 7.6 mm. and had closed to 1 mm. How can this be explained?

TABLE IX. MESIODISTAL DIAMETERS OF TEETH (ROGER)

		DECIDUOUS										
				LEFT					RIGHT			
	TOTAL	E	D	C	B	A	A	B	C	D	E	TOTAL
Maxilla	33.4	8.2	7.2	6.7	5	6.3	6	5	6.4	7.3	8.4	33.1
Mandible	29.2	8.4	7	5.6	4.2	4	4	4.4	5.4	7.2	8.7	29.7
		PERMANENT										
				LEFT					RIGHT			
	TOTAL	5	4	3	2	1	1	2	3	4	5	TOTAL
Maxilla	36.3	6*	6.7	7.5	6.8	9.3	8.9	6.4	7.3	6.7	6	36.3
Mandible	31.1	6.4	6.6	7.1	5.5	5.5	5.4	5.5	6.8	6.8	6.5	31

*Dimension of right second premolar substituted. Deciduous second molar still in place.

Certain dimensional changes take place prematurely on the right side due to the loss of a tooth, but these changes also occurred on the left side later where no tooth was lost. In other words these are changes of normal adjustment; only the timing was different.

Barbara's curves showed significant differences of dimensions 1 to 6 (Fig. 8). At birth dimension 4 for both jaws was affected on the left side of the arch and the rate of growth of this dimension was markedly different from its mate on the right side, dimension 1. Since this marked asymmetry disappeared, perhaps it was due to the molding process during delivery. Dimensions 3 and 6 in the mandible at 10 years, 2 months showed marked differences, with dimension 3 showing a decrease. The mandibular first permanent molars were lost at different times prior to 10 years, 2 months. The mandibular permanent second molars had erupted and were slightly rotated. The space that was occupied by the first molar (Fig. 9) had a mesiodistal diameter of 10.7 mm., and had closed to 1.7 mm. What is important is that at 12 years of age the asymmetry of dimensions is not significant.

TABLE X. MESIODISTAL DIAMETERS OF TEETH (SKIPPY)

						DECIDUOUS						
				LEFT					RIGHT			
	TOTAL	E	D	C	B	A	A	B	C	D	E	TOTAL
Maxilla	36	8.9	7.3	7.4	5.8	6.6	6.4	5.4	7.2	7.4	9	35.6
Mandible	32.2	9.5	7.7	6.4	4.6	4	4	4.6	6.5	7.6	9.6	33.3
						PERMANENT						
				LEFT					RIGHT			
	TOTAL	5	4	3	2	1	1	2	3	4	5	TOTAL
Maxilla	37.9	6.8	7.4	8.2	7	8.5	8.5	7	8.2	7.2	6.8	37.7
Mandible	32.6	7	7.2	7	6	5.4	5.4	6	7.2	7.4	7	33

TABLE XI. MESIODISTAL DIAMETERS OF TEETH (BARBARA)

						DECIDUOUS						
				LEFT					RIGHT			
	TOTAL	E	D	C	B	A	A	B	C	D	E	TOTAL
Maxilla	33.3	8.1	6.8	6.8	5.2	6.4	6.4	5	6.7	6.5	8	32.6
Mandible	31.5	9.5	7.6	5.7	4.7	4	4	4.7	5.7	7.6	9.8	31.8
						PERMANENT						
				LEFT					RIGHT			
	TOTAL	5	4	3	2	1	1	2	3	4	5	TOTAL
Maxilla	36.1	6.6	6.6	7.2	6.3	9.4	9.2	6.3	7.2	6.5	6.5	35.7
Mandible	34.9	*9.5	6.7	6.7	6	6	6	6	6.7	6.7	*9.8	35.2

*Second deciduous molars. Second premolar missing.

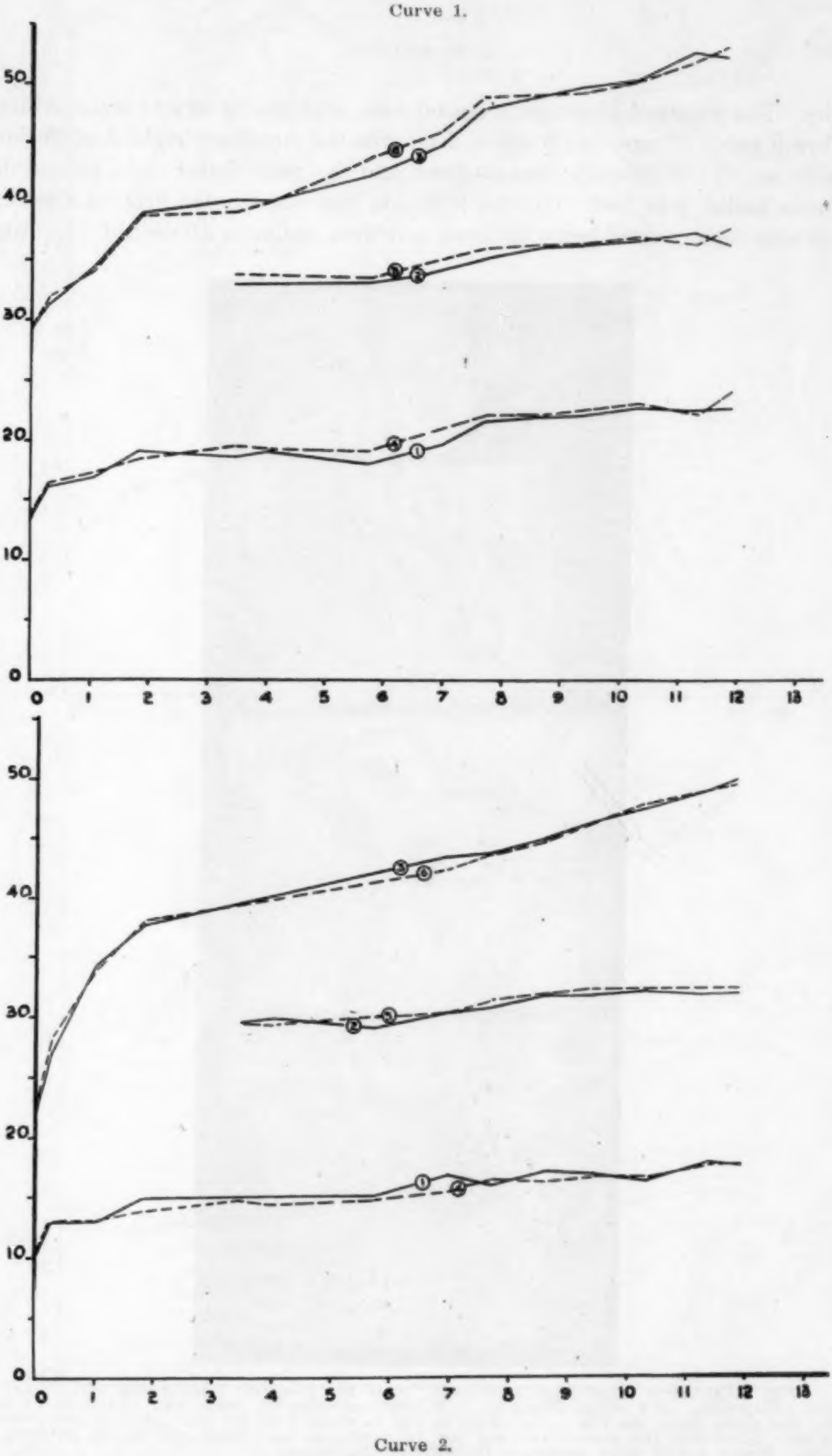
TABLE XII. MESIODISTAL DIAMETERS OF TEETH (MARIE)

						DECIDUOUS						
				LEFT					RIGHT			
	TOTAL	E	D	C	B	A	A	B	C	D	E	TOTAL
Maxilla	35.2	8.5	7.4	7	5.6	6.7	6.8	5.6	6.8	7.4	8.6	35.2
Mandible	31.2	9.4	7.5	5.4	4.8	4.1	4.1	5	5.6	7.6	9.5	31.8
						PERMANENT						
				LEFT					RIGHT			
	TOTAL	5	4	3	2	1	1	2	3	4	5	TOTAL
Maxilla	36.5	6.4	7.2	8	6.3	8.6	9	6.3	8*	7.2	6.4	37.1
Mandible	32.3	7.4	7.2	6.3	6	5.4	5.5	6	6.3	7	7.2	32

*Deciduous canine still in place. Measurement of permanent canine approximated.

Marie's dental development during her first two years was unique. At 1 year, 8 months there existed a marked overbite, whereas at 2 years this was reduced to a relatively good relationship which is maintained throughout the

Curve 1.



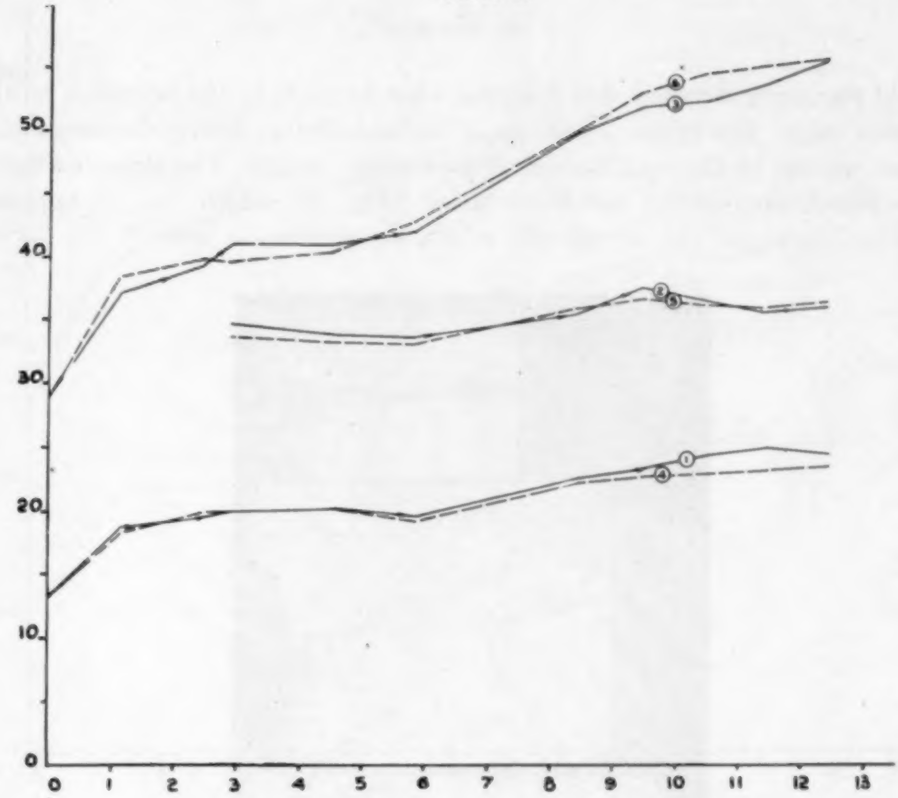
Curve 2.

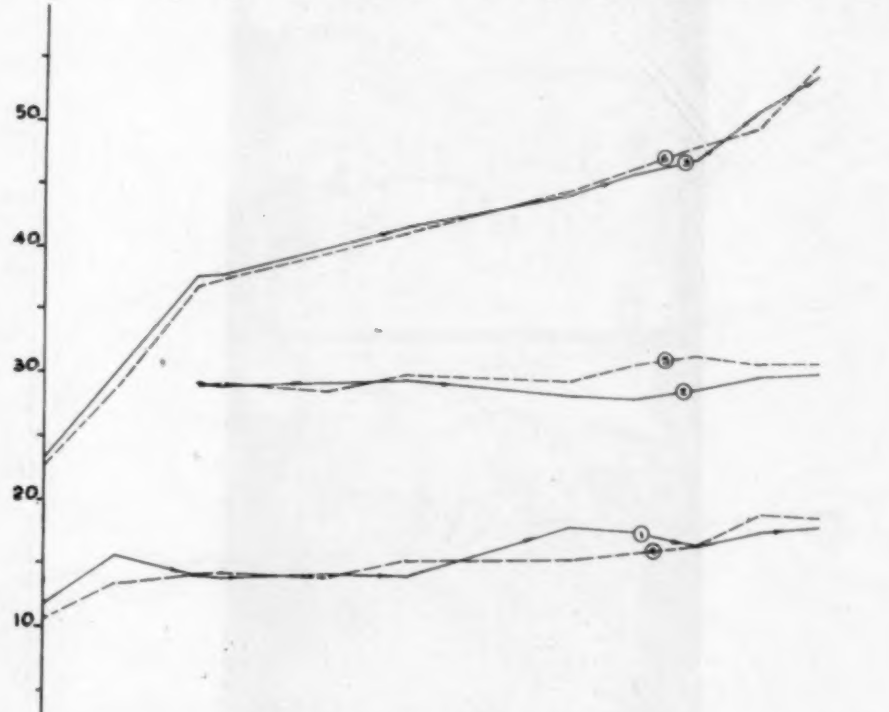
Fig. 4.—Curve 1: Maxillary curves for dimensions 1-6 (Roger). Curve 2: Mandibular curves for dimensions 1-6 (Roger).

series. She received inadequate dental care, and the ill effects were evident before 5 years of age. At 6 years, 7 months the maxillary right first deciduous molar was completely broken down and the mandibular right second deciduous molar was lost. On the left side the mandibular first and second deciduous molars were badly decayed and were lost soon afterward. In order

Fig. 5.—Roger's casts, right side view. Note the posterior relationship at 3 days; the good relationship at 4 years, 1 month; 8 years, 8 months, 23 days; and 12 years, 19 days. The last casts show the bite open. This is due to contact of the gum pads in the posterior region. Note that the premolars have not fully erupted and there are spaces between the teeth. Roger has a good occlusion throughout his series.

Curve 3.





Curve 4.

Fig. 6.—Curve 3: Maxillary curves for dimensions 1-6 (Skippy). Curve 4: Mandibular curves for dimensions 1-6 (Skippy).

to avoid too many details I will describe what happens to the occlusion on the right side only. The relative position of the mandibular first permanent molar is 4 mm. mesial to the maxillary first permanent molar. The space occupied by the mandibular second deciduous molar (Fig. 10) which was 9.5 mm. has closed to 3 mm., yet the asymmetry of the dimensions as seen by the curves

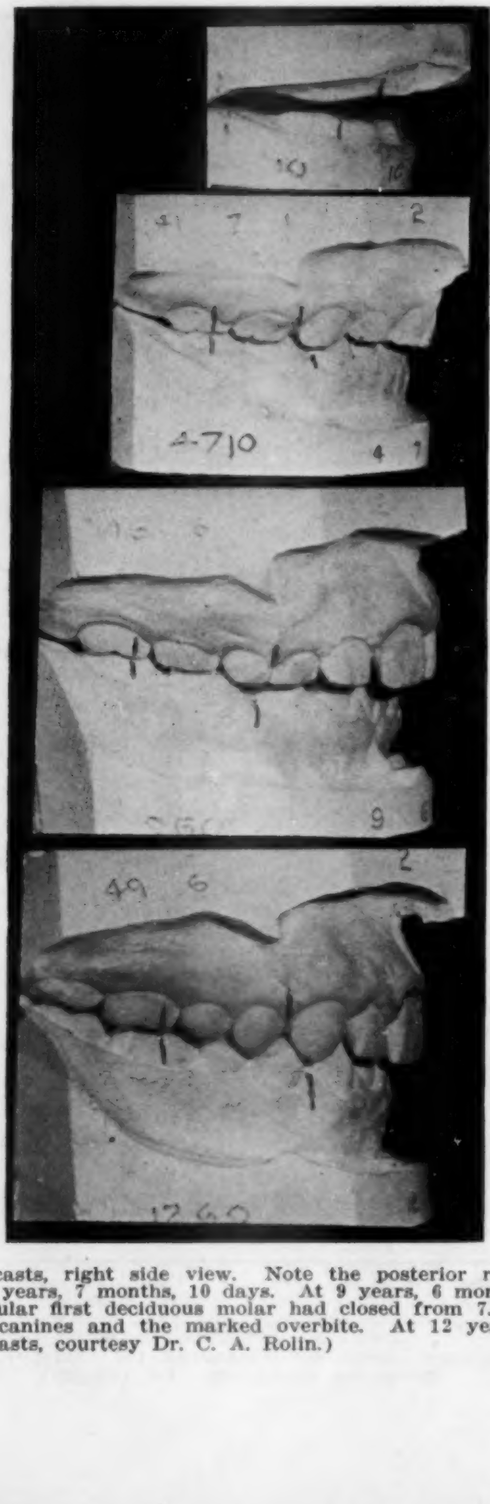
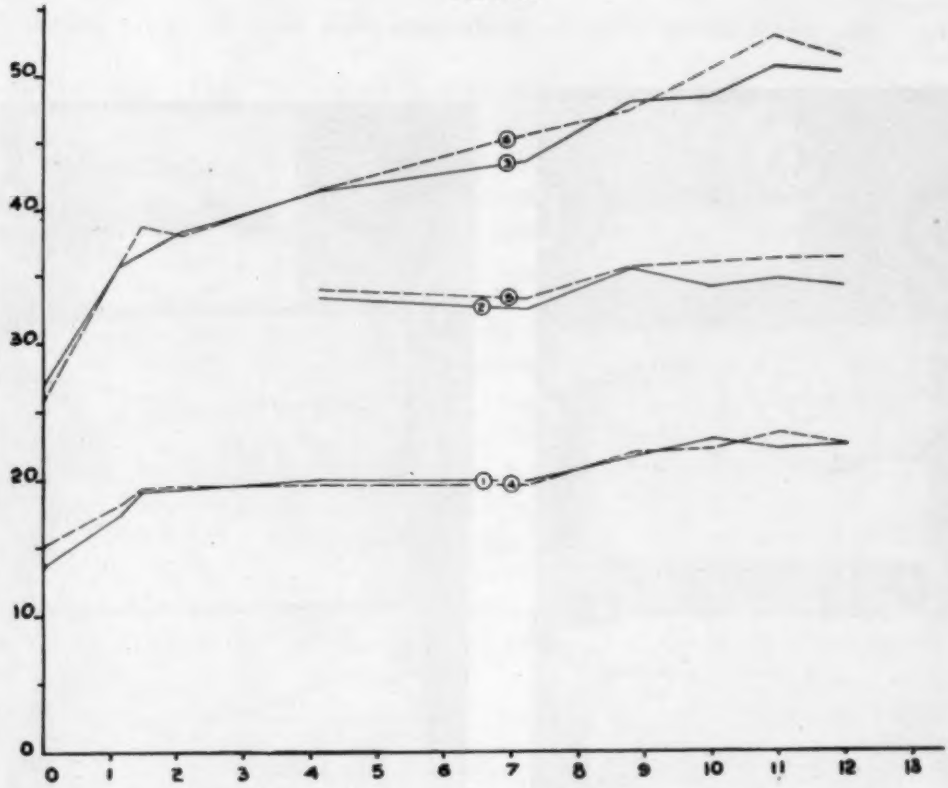
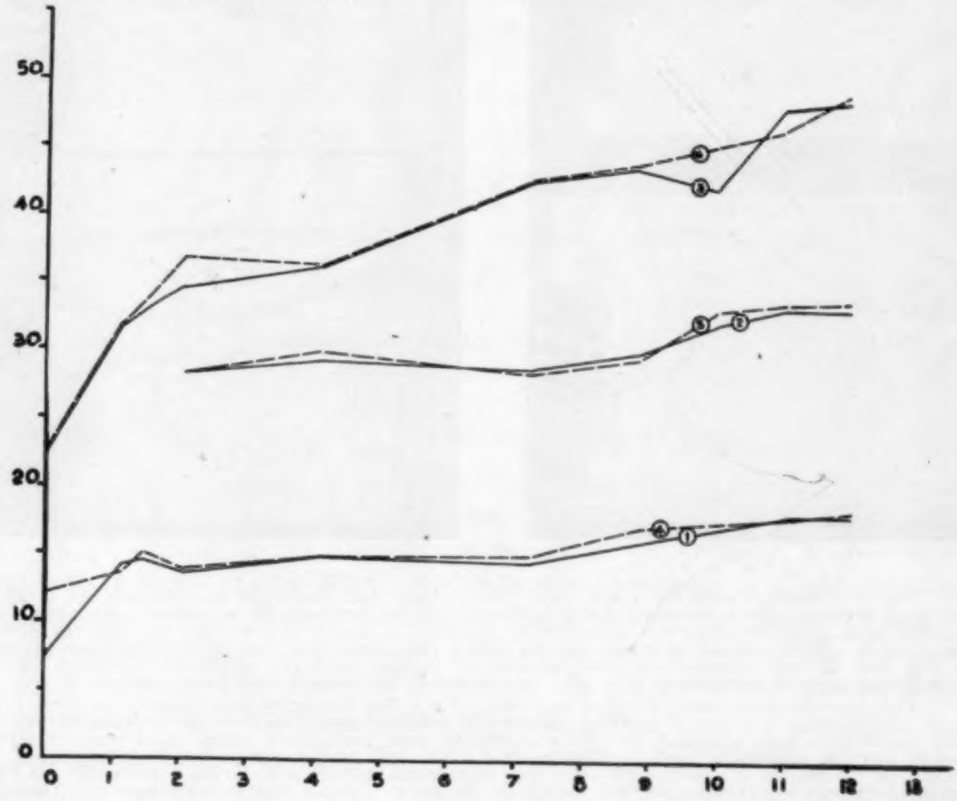


Fig. 7.—Skippy's casts, right side view. Note the posterior relationship at 10 days, the good occlusion at 4 years, 7 months, 10 days. At 9 years, 6 months the space that was occupied by the mandibular first deciduous molar had closed from 7.6 mm. to 1 mm. Note the malposition of the canines and the marked overbite. At 12 years, 6 months note the good occlusion. (Last casts, courtesy Dr. C. A. Rolin.)

Curve 5.





Curve 6.

Fig. 8.—Curve 5: Maxillary curves for dimensions 1-6 (Barbara). Curve 6: Mandibular curves for dimensions 1-6 (Barbara).

Fig. 9.

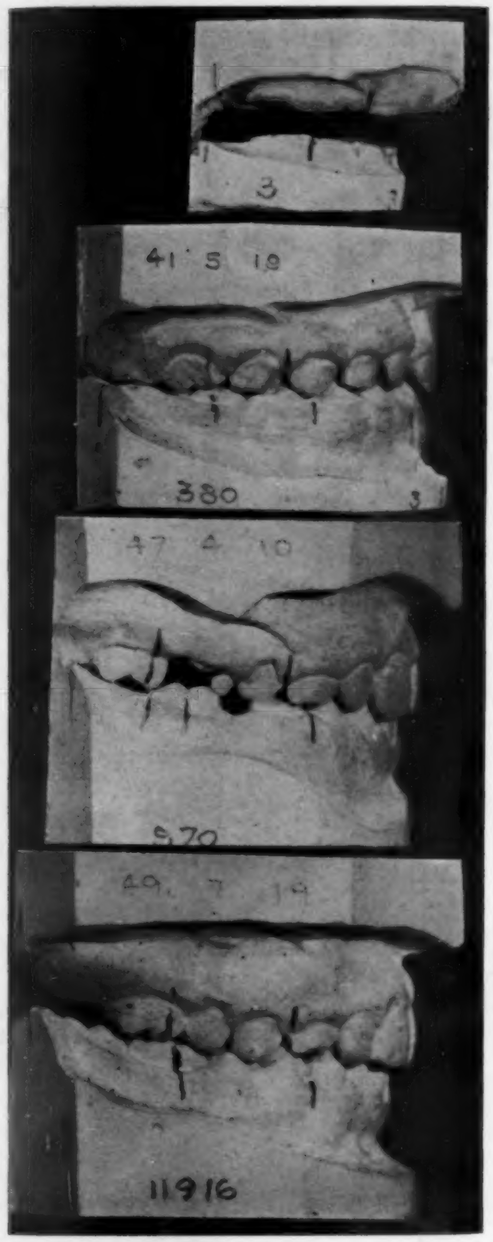


Fig. 10.

Fig. 9.—Barbara's casts, right side view. Note the posterior relationship at 6 days; the good occlusion at 4 years, 2 months, 10 days. At 8 years, 10 months, 7 days note the marked open-bite between the anterior teeth, and a slight change in the anteroposterior relationship of the dental arches. At 12 years, 28 days note the good occlusion in spite of the loss of two mandibular first permanent molars and the congenital absence of the mandibular second premolars, with the retention of the second deciduous molars.

Fig. 10.—Marie's casts, right side view. Note the posterior relationship at birth; the good occlusion at 3 years, 8 months. Note the marked dental neglect at 9 years, 7 months. The space that was occupied by the mandibular first permanent molar is 4 mm. relatively mesial to the maxillary molar. The median line and the anteroposterior relationship are good. At 11 years, 9 months, 16 days the permanent molars are in good occlusion, and the anteroposterior relationship of the dentition is good. (Last casts, courtesy Dr. DeForest Whitmarsh.)

is not unusual (Fig. 11). With loss of teeth some of our measuring points are affected, thus accentuating the asymmetry.

Let us now consider curves 9 to 16 (Figs. 12, 13, 14, and 15) for length and width. Roger's dimension 7 for the maxilla had an increase between 2 years and 12 years of approximately 5 mm., whereas the rest of the children had a varied increase of from 1.5 to 4 mm. They all showed a loss of dimension around the sixth year, with the exception of Barbara who showed no change in dimension from the second to the seventh years. Marie, on the other hand, showed no change in dimension from the second to almost the ninth year, while Roger's curve was constantly changing. In general, dimension 7 in the mandible for all the children had a similar character.

All the children showed an increase from 1 to 3 mm. for dimension 8 in the maxilla. In the mandible, however, Roger and Barbara showed an increase of 2 mm., while Skippy showed a decrease of 0.5 mm. and Marie showed no change. Throughout the literature it is reported that there is no change in arch length between the deciduous dentition and its successors. My findings show that this generalization does not necessarily apply to the individual child.

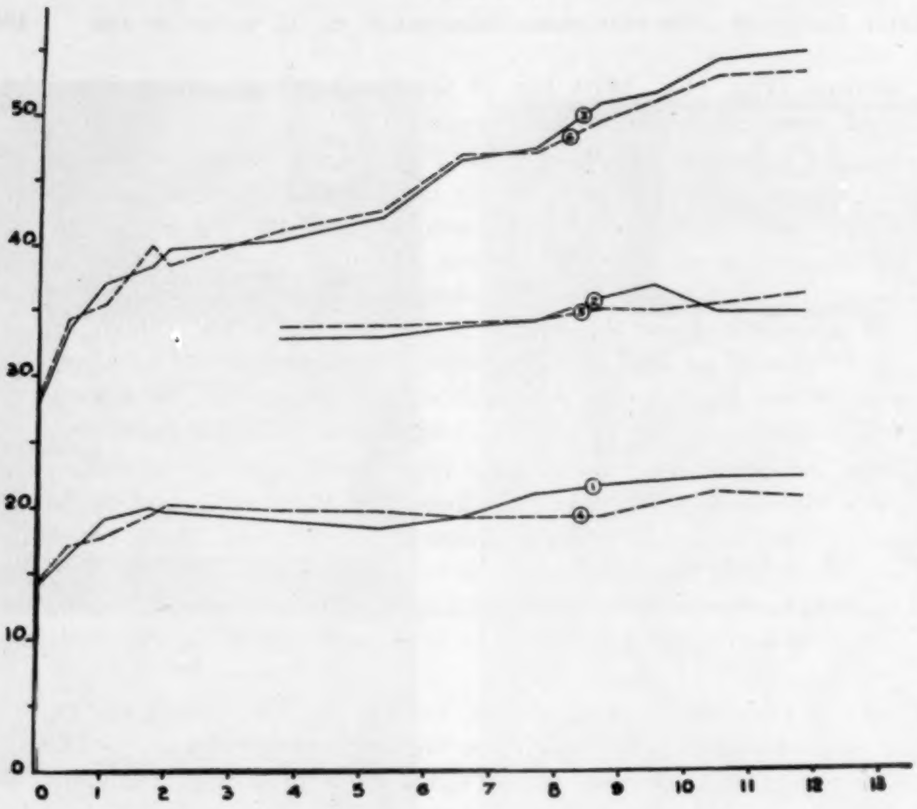
The total arch length, dimension 9, has the greatest magnitude and the greatest rate of change. Although the region of the permanent molars accounts for the greatest portion of this change, one should not think that the region anterior to it is not undergoing change simultaneously. It is only a matter of degree.

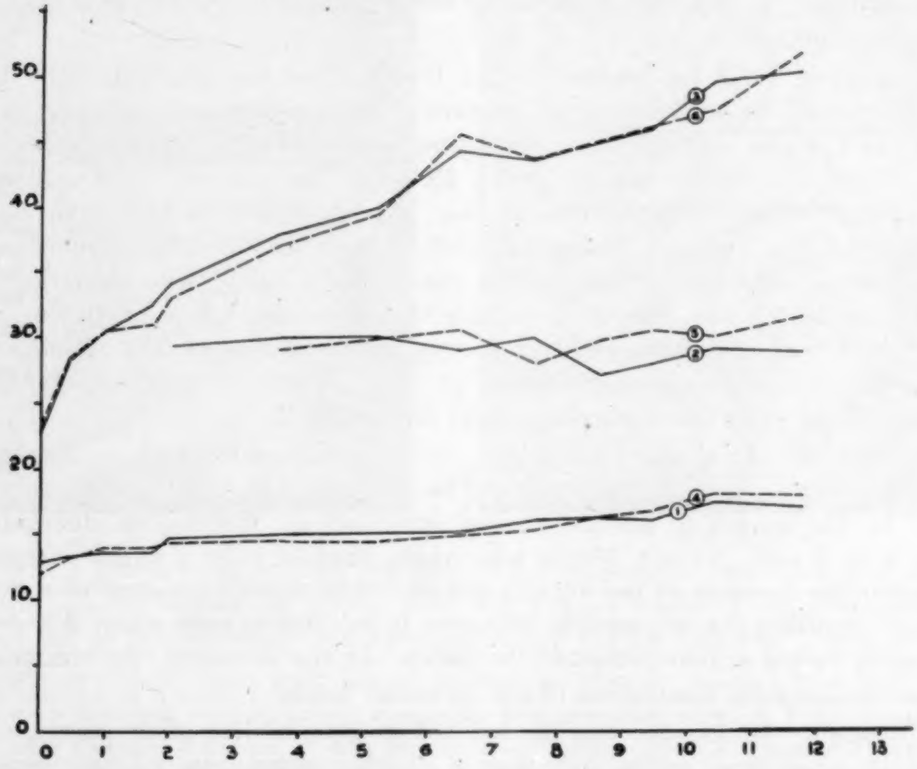
Dimension 10 in the maxilla for all the children has relatively little increase between the second and sixth years and the eighth and twelfth years, except in the case of Barbara, whose dimension showed a constant increase from the second to the twelfth year. However, she was the only one who showed a decrease in dimension between 1 year, 5 months and 2 years, 1 month. All the children showed a total increase in dimension from 3 to 5 mm. between the second and twelfth years except Marie, who showed only an increase of 1.5 mm. In the mandible this dimension has a particular interest, inasmuch as all the children showed a decrease in part of its course. Marie showed a decrease of dimension at three periods, Skippy and Barbara in two periods, while Roger showed a slight decrease at 12 years.

Dimension 11 in the maxilla for all the children showed an increase from 4 to 6 mm., except for Marie, whose increase was a little more than 1 mm. In the mandible all the curves exhibited an increase in dimension from 3 to 7 mm., except Marie who again showed only a slight increase similar to the increase of her maxillary arch. Although dimensions 10 and 11 for the maxilla do have a certain character in relation to each other, this does not apply to the entire course of the curve. In the mandible, the character and course between dimensions 10 and 11 is also varied.

Dimension 12 for the maxilla behaves in general like other curves, i.e., rapid increase from birth and then a slowing down; an increase again, and then another period of slowing down. In the mandible there is a similar

Curve 7.

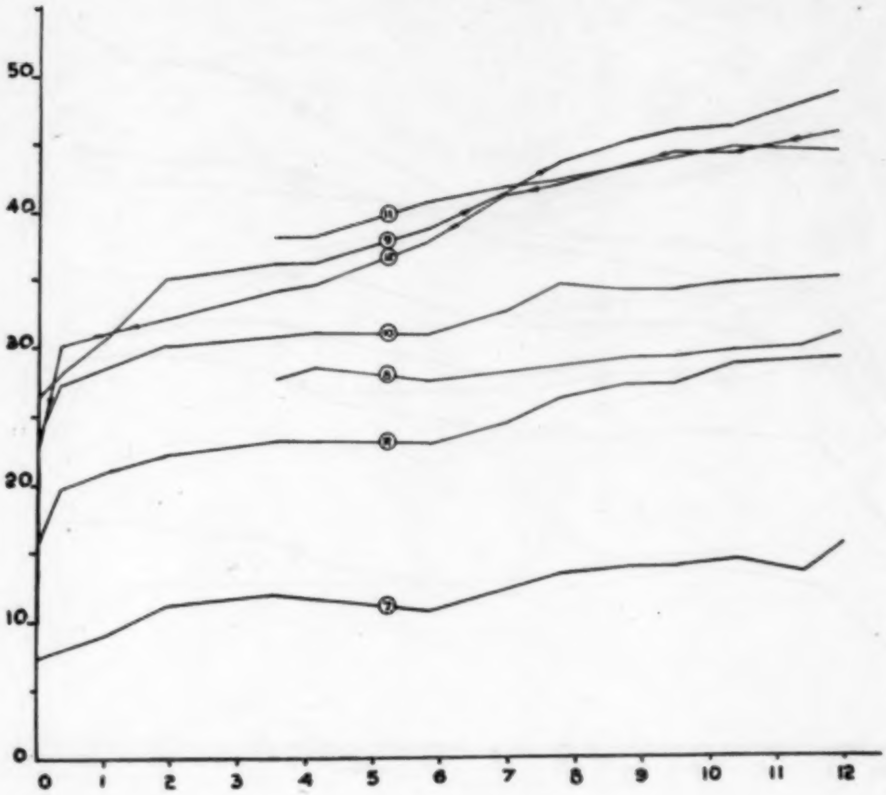


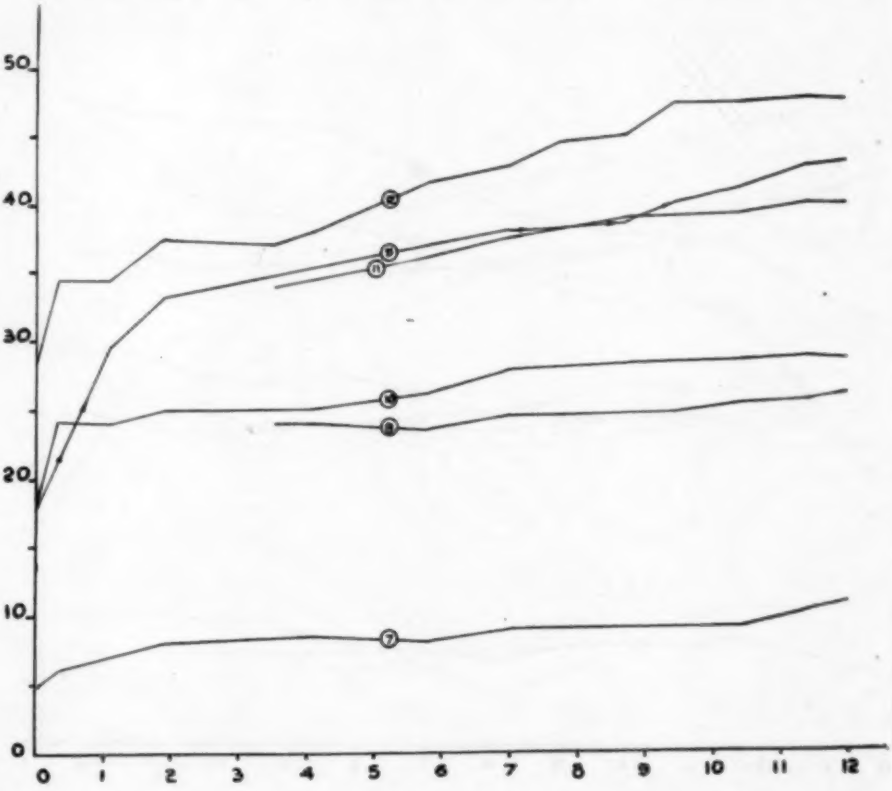


Curve 8.

Fig. 11.—Curve 7: Maxillary curves for dimensions 1-6 (Marie). Curve 8: Mandibular curves for dimensions 1-6 (Marie).

Curve 9.

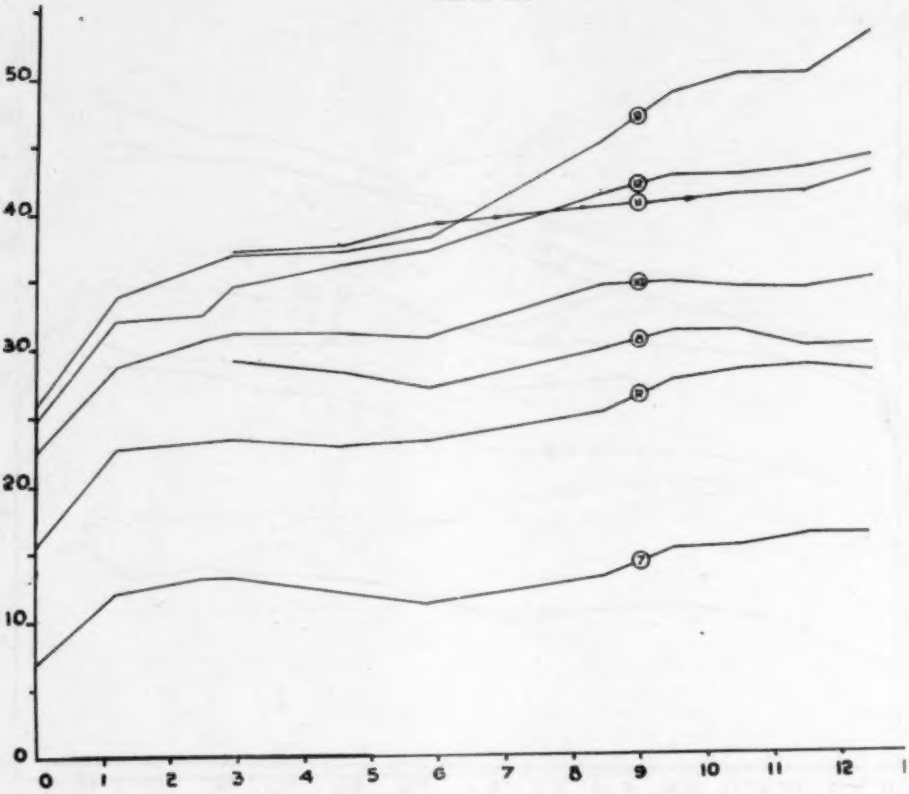


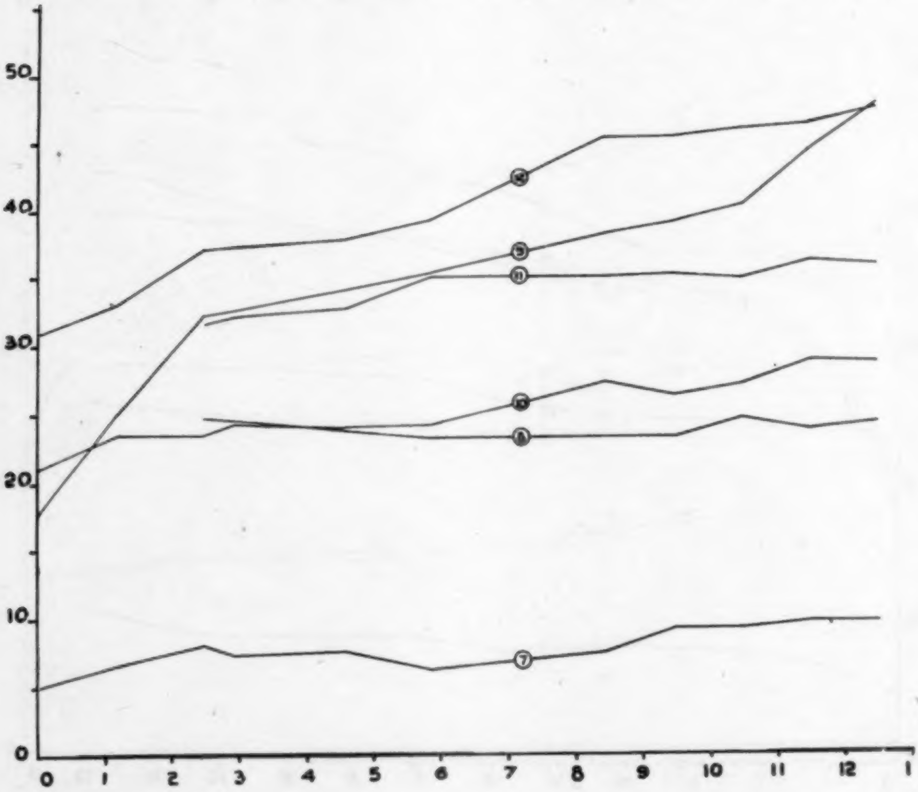


Curve 10.

Fig. 12.—Curve 9: Maxillary curves for dimensions 7-12 and R (Roger). Curve 10: Mandibular curves for dimensions 7-12 (Roger).

Curve 11.

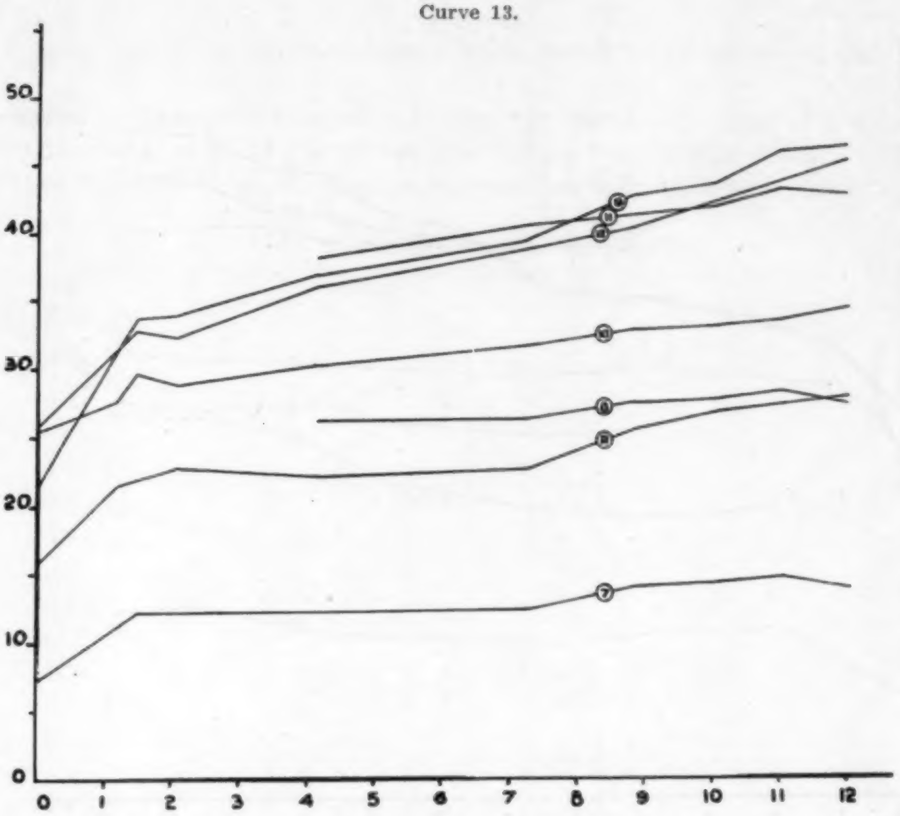


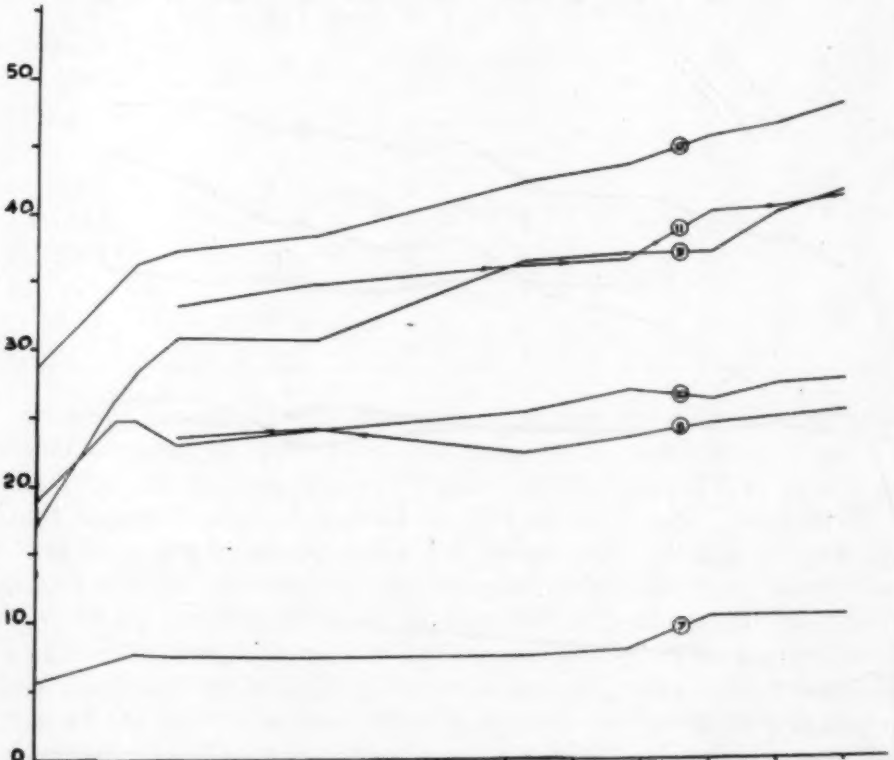


Curve 12.

Fig. 13.—Curve 11: Maxillary curves for dimensions 7-12 and R (Skippy). Curve 12: Mandibular curves for dimensions 7-12 (Skippy).

Curve 13.

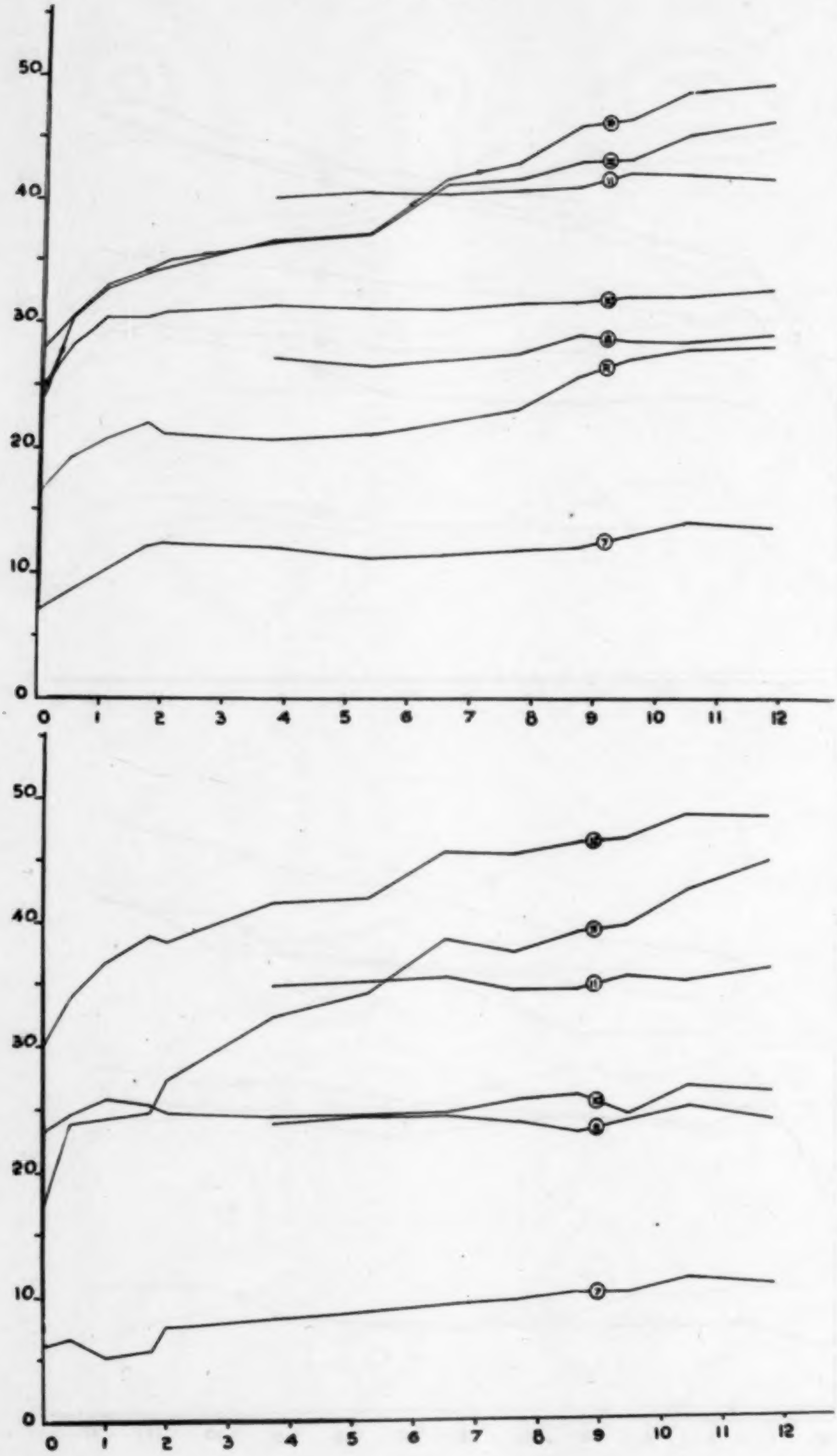




Curve 14.

Fig. 14.—Curve 13: Maxillary curves for dimensions 7-12 and R (Barbara). Curve 14: Mandibular curves for dimensions 7-12 (Barbara).

Curve 15.



Curve 16.

Fig. 15.—Curve 15: Maxillary curves for dimensions 7-12 and R (Marie). Curve 16: Mandibular curves for dimensions 7-12 (Marie).

character to that of the maxilla, except for Marie, who showed a departure from the usual slope of the curve from 1 year, 8 months to 2 years. This departure is shown in many of her curves and has been explained previously.

TABLE XIII. DENTAL FORMULA (ROGER)

AGE	RIGHT						LEFT					
3 da.												
4 mo.												
						a	a					
1-1					b	a	a	b				
					b	a	a	b				
1-11			d	c	b	a	a	b	c	d		
			d	c	b	a	a	b	c	d		
3-6		e	d	c	b	a	a	b	c	d	e	
		e	d	c	b	a	a	b	c	d	e	
4-1					same		same					
					same		same					
5-10		e	d	c	b	a	a	b	c	d	e	
		e	d	c	b	1	1	b	c	d	e	
7		e	d	c	–	1	1	b	c	d	e	6
	6	e	d	c	2	1	1	b	c	d	e	6
7-8-23	6	e	d	c	2	1	1	2	c	d	e	6
	6	e	d	c	2	1	1	2	c	d	e	6
8-8-23					same		same					
					same		same					
9-6					same		same					
					same		same					
10-5	6	e	d	c	2	1	1	2	c	d	e	6
	6	e	d	3	2	1	1	2	–	d	e	6
11-5-4	6	e	4	3	2	1	1	2	3	4	e	6
	6	5	4	3	2	1	1	2	3	4	5	6
12	6	5	4	3	2	1	1	2	3	4	e	6
	6	5	4	3	2	1	1	2	3	4	5	6

In order to visualize the total picture of how the dental arches change in size and morphology with time, I made occlusal outlines of Roger's dental arches (Fig. 16) passing through Points I, II, III, and IV at ages 3 days; 4 years, 1 month; 7 years, 9 months; and 12 years, 19 days, respectively. Each age was then superimposed upon the others using Points I to IV and the sagittal plane for orientation. It can readily be seen that change was constantly taking place, because at no time did both the length and the width of a particular dimension remain unchanged jointly. This continuous change is best illustrated by a study of the corresponding vector dimensions and the outline of the dental arches. The change of dimension is a factor of size whereas the rate of change (the slope of a curve) between curves in the same jaw has to do with morphology. The change in dimension and the rate of change of the different curves between each jaw has to do with relationship

of the jaws. The meaning of these changes must be considered in relation to the size of the deciduous teeth and their successors (Tables IX to XII) and also the dental formula with respect to time (Tables XIII to XVI). These factors and others of your choice should be evaluated in terms of the existing occlusion.

The use of the words forward and backward movement of teeth has been omitted intentionally. Teeth may be carried relatively backward while at the same time they may be moving forward through the alveolus, or vice versa. This may sound ambiguous, but actually it is not. For example, suppose a train is traveling north at 60 miles an hour, and a man is walking through the train in the same direction. The man is going forward by the movement of the train, and also going forward by walking through the train.

TABLE XIV. DENTAL FORMULA (SKIPPY)

AGE	RIGHT							LEFT						
10 da.														
1-2-14						b	a	a	b					
						b	a	a						
2-5-11				d	c	b	a	a	b	c	d	e		
			e	d	c	b	a	a	b	c	d	e		
2-11-10			e	d	c	b	a	a	b	c	d	e		
			e	d	c	b	a	a	b	c	d	e		
4-7-10							same	same						
							same	same						
5-10			e	d	c	b	a	a	b	c	d	e		
			e	d	c	b	1	1	b	c	d	e		
8-5		6	e	d	c	b	1	1	–	c	d	e	6	
		6	e	–	c	2	1	1	2	c	d	e	6	
9-6		6	e	d	c	2	1	1	2	c	4	e	6	
		6	e	–	.c	2	1	1	2	c	d	e	6	
10-6-9		6	e	4	c	2	1	1	2	c	4	e	6	
		6	e	4	3	2	1	1	2	c	d	e	6	
11-6-9		6	5	4	3	2	1	1	2	3	4	5	6	
	7	6	5	4	3	2	1	1	2	3	4	5	6	
12-6	7	6	5	4	3	2	1	1	2	3	4	5	6	7
	7	6	5	4	3	2	1	1	2	3	4	5	6	7

Now suppose the train reverses its direction while the man keeps on walking through the train. Under these conditions the man is going forward through the train but is actually being carried backward by the train. Theoretically, both of these conditions, and other combinations, may be happening to the dental arches and the surrounding structures. What is not theoretical is that we have relative dimensional changes and that these changes have different rates occurring at different parts of the arch. An appropriate understanding of these facts should give one a clearer insight of how these children arrive at a common end result, good occlusion.

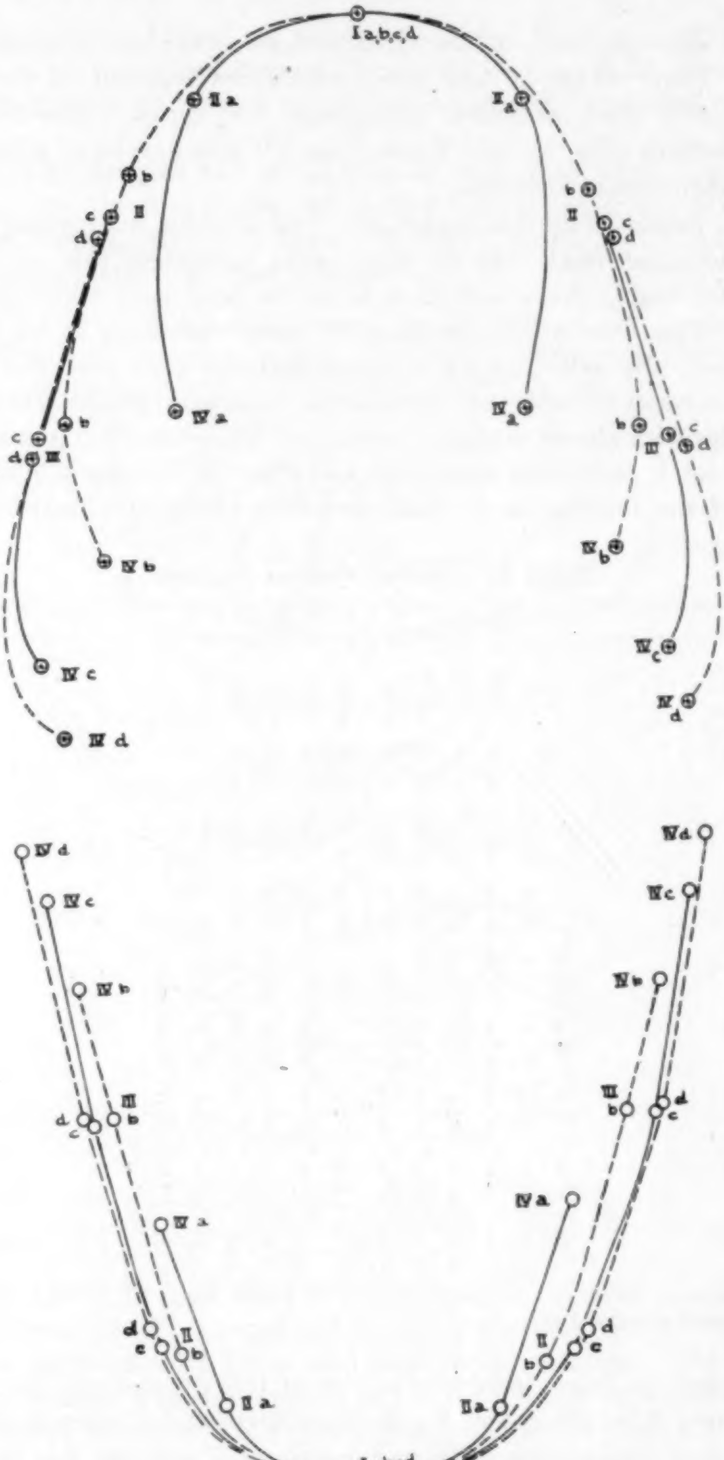


Fig. 16.—Occlusal outline of Roger's dental arches passing through Points I, II, III, and IV. Letters *a*, *b*, *c*, and *d* represent the ages of 3 days; 4 years, 1 month; 7 years, 8 months, 23 days; and 12 years, 19 days, respectively. There is no Point III at 3 days. (Outline made with Stanton Pantograph.)

Let us examine some of the casts and see what has happened to their occlusion. Roger (Fig. 5) had good dental development of the anatomic landmarks and good occlusion throughout his series. However, Skippy (Fig. 7), Barbara (Fig. 9), and Marie (Fig. 10) also developed good occlusion in spite of their dental histories.

Can we explain why this happened? The alveolus is a process that exists only by virtue of teeth. If all teeth were extracted, this process would atrophy with time. We would then have the base upon which this process was built. This base would not have as many variations as we find in the dental arches. By selecting for measurement the most posterior point (R) on the rugae many variables are eliminated. This point can be traced throughout the series with almost pin-point accuracy. The vector distance is measured between Point I, previously described, and Point R. I believe dimension R is an index of the foundation or basal structure of the maxillary dental arch.

TABLE XV. DENTAL FORMULA (BARBARA)

AGE	RIGHT							LEFT						
6 da.														
1-1-27				d		b	a	a	b		d			
						b	a	a	b					
1-5-12				d	c	b	a	a	b	c	d			
				d	c	b	a	a	b	c	d			
2-0-25				d	c	b	a	a	b	c	d			
			e	d	c	b	a	a	b	c	d	e		
4-2-10			e	d	c	b	a	a	b	c	d	e		
			e	d	c	b	a	a	b	c	d	e		
7-3-6		6	e	d	c	b	1	1	b	c	d	e	6	
		6	e	d	c	b	1	1	b	c	d	e	6	
8-10-7		6	e	4	c	2	1	1	2	c	d	e	6	
		6	e	d	c	2	1	1	2	c	4	e	6	
10-1-28		6	5	4	c	2	1	1	2	c	d	e	6	
		*	e′	4	3	2	1	1	2	3	4	e′	*	
11-1-1		6	5	4	3	2	1	1	2	c	4	5	6	
	7	–	e	4	3	2	1	1	2	3	4	e	–	
12-0-28		6	5	4	3	2	1	1	2	3	4	5	6	
	7	–	e	4	3	2	1	1	2	3	4	e	–	7

*Extracted.
′ Congenital missing 5's.

What can we learn from an analysis of this dimension? Let us look at Roger's Curve 9 for dimension R. Between birth and 3 years, 6 months there was a gradual deceleration with an increase of 7 mm. for this period. This was followed by a plateau from 3 years, 6 months to 5 years, 10 months. From 5 years, 10 months to 10 years, 3 months there was an increase in dimension of more than 5 mm., and from then on a second plateau.

Skippy's Curve 11 had an increase of 7 mm. between birth and 2 years, 5 months; a plateau from 2 years, 5 months to 5 years, 10 months; from 5 years, 10 months to 10 years, 6 months an increase of 5 mm. and then a second plateau.

Barbara's Curve 13 had an increase of more than 6 mm. from birth to 2 years, 1 month; the first plateau running from 2 years, 1 month to 7 years, 3 months; an increase of 5 mm. from 7 years, 3 months to 12 years, 1 month with no second plateau, at least to date.

Table XVI. Dental Formula (Marie)

AGE	RIGHT							LEFT						
3 da.														
5 mo.														
1 yr.						b	a	a	b					
							a	a						
1-8				d		b	a	a	b		d			
				d		b	a	a	b		d			
2 yr.				d	c	b	a	a	b	c	d			
			e	d	c	b	a	a	b	c	d			
3-8			e	d	c	b	a	a	b	c	d	e		
			e	d	c	b	a	a	b	c	d	e		
5-3							same	same						
							same	same						
6-7			e	d	c	b	a	a	b	c	d	e		
		6	*	d	c	b	a	a	b	c	d	e	6	
			–				1							
7-8		6	e	4	c	b	a	a	b	c	d	e	6	
		6	–	d	c	b	1	1	2	c	–	–	6	
8-8		6	e	4	c	b	1	1	b	c	d	e	6	
		6	–	d	c	2	1	1	2	c	–	–	6	
9-7		6	5	4	c	2	1	1	2	c	d	e	6	
		6	–	d	c	2	1	1	2	c	–	–	6	
10-6-27		6	5	4	c	2	1	1	2	c	d	e	6	
	7	6	5	4	3	2	1	1	2	c	d	e	6	
11-9-16		6	5	4	c	2	1	1	2	c	d	e	6	
	7	6	5	4	3	2	1	1	2	3	4	5	6	7

*Extracted.

Marie's Curve 15 from birth to 2 years had an increase of almost 5 mm.; the first plateau between 2 years and 5 years, 3 months; from 5 years, 3 months to 10 years an increase of 7 mm. and then another plateau. She also showed a variation between 1 year, 8 months and 2 years which appeared in her other dimensions, and therefore it is a factor that is unique for this child.

Roger's and Skippy's curves were practically identical as to character and magnitude. The timing, of course, was different. Barbara, too, had common characteristics for the main portion of the curve. Marie also was similar to the rest of the children, except for dimensional differences and timing.

The curves for this dimension R for all the children had a common character with certain individual latitudes. They were smooth and rhythmic which is characteristic of good development. I believe that this accounts in part for the common end result of these children—good occlusion.

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667 MADISON AVE.

ANALYSIS OF THE COMPONENTS OF FORCES USED TO EFFECT DISTAL MOVEMENT OF TEETH

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INTRODUCTION

THE technique for the application of force by orthodontists to effect the movement of teeth has been developed progressively for over a hundred years. Since biologic and not purely mechanical entities are dealt with, it has been necessary that techniques be developed in conformity with the reaction of tissues and not with engineering formulae.

Interpretation of the mechanical aspects of orthodontic appliances is done frequently and various "philosophies" of treatment are built on these interpretations. This paper will not interpret or evolve any "philosophy" of treatment new or old.

It is necessary to understand the forces at work when an orthodontic appliance is inserted into the mouth. This paper will attempt to make clear one aspect of the mechanical basis for the biologic response to mechanotherapy.

HISTORICAL RÉSUMÉ

According to Weinberger,[17] Gunnell first used the headgear for occipital anchorage in 1822 or 1823. Kneisel, in 1836, published a report on his use of the headgear as occipital anchorage for the correction of a mandibular protrusion. Schange published a report on the use of the headgear in 1841.

Edward Maynard brought about distal movement of teeth in a case described in 1843 in *The American Journal of Dental Science* by extracting both of the upper first premolars and passing an elastic thread around the cuspid and first molar on each side. After bringing back the cuspid, the lateral and central incisors were brought back into line by the use of gum-elastic and hickory springs. In this case, colinear forces only were used to accomplish distal movement.

In 1845 Robert Arthur, in "A Popular Treatise on Diseases of the Teeth," brought about distal movement of the upper teeth by first extracting the upper first or second premolars and forcing the anterior teeth back into the space thus created with the daily insertion of paper wedges of increasingly greater thickness between the anterior teeth, thus forcing them distally. Here again we have a colinear force used for distal movement of teeth.

This thesis was submitted to the American Board of Orthodontics in partial fulfillment of the requirements for certification.

James Robinson described in *The Dental Review*, London (1859), "The Causes of Irregularities of the Teeth," a method of moving the upper anterior teeth distally by use of an upper plate to which flat or circular spiral springs or elastic bands are ligated, the other end of the coil spring or elastic band being fastened to the irregularly placed anterior teeth.

Elisha Gustavus Tucker in the *American Journal of Dental Science* (1850) introduced the use of elastic rubber bands in the form of tubing cut into thin pieces. Tucker, on giving this very important contribution to the profession, said on page 95 of "On Irregularity of the Teeth" (*Dental News Letter*, 1853), as follows:

> Though simple, these rings cannot be used with advantage, unless applied with the utmost care, indeed, a careless application of them may create new difficulties, or aggravate old ones. The exact position of the teeth, the line of force to be observed, and the tensity of the power to be exerted, are all considerations requiring study, and a careful judgment.

William Rogers in 1845 used a key and rachet device to effect distal movement of anterior teeth.

In 1854 Thomas W. Evans described in the *Dental News Letter*, "On Regulation of Teeth," a technique for correcting the protrusion of anterior teeth by means of a flat wire with incisal stabilizing hooks on the central incisors using the tension of two coil springs anchored to the molars to bring about the distal movement of the anterior teeth.

Walter W. Allport in the *Dental Register of the West* (1857) described a method of moving anterior teeth distally by means of a screw device using a flat anterior wire and a lingual plate for stabilization.

In 1866 a report was made of a case in which Norman W. Kingsley used a headgear to depress and drive the anterior teeth distally after extracting the upper first premolar on each side.

In 1892 Kingsley[9] described in *Dental Cosmos* a technique for driving the upper teeth distally by means of a headgear without extraction of any teeth.

John Nutting Farrar, in 1895, with his "mechanism for moving the roots forward en masse" set up a fulcrum on the incisal edge of the tooth with a force acting at the neck, drawing the tooth and root in a posterior direction "bodily." There was not, with this mechanism, a center of rotation set up in the root area.

Intermaxillary elastics were introduced by Dr. Calvin S. Case before the Columbia Dental Congress in 1893. At about the same time, Dr. H. A. Baker used intermaxillary elastics for treatment of a Class II case, but this was not brought to the attention of the orthodontic profession until Dr. Edward H. Angle presented this revolutionary technique in 1903 in the *International Dental Journal.*

Simeon H. Guilford in 1889 formulated rules for the application of force to teeth as follows:

> The greatest good can be obtained from any force when it is exerted in a direct line with the movement desired. The force applied must be sufficient, but it should not be more than sufficient, nor too abruptly applied. Pressure should be exerted as nearly as possible in a line at right angles to the long axis of the tooth.

DISCUSSION OF PROBLEM

Distal movement of teeth is obtained at present in most orthodontic cases by the use of small elastic bands attached to a basic appliance. In most cases coil springs or loop springs of gold or nickle-chrome-steel alloy may be used as adjuncts. Under the normal arrangement, one end of the small elastic band is fastened to an appliance arranged in such a manner that it is relatively fixed or immovable in the mouth. The other end of the elastic is fastened to an appliance which transmits the force to the tooth or teeth to be moved.

Elastics are used generally in three different possible anchorage-movement combinations, the intramaxillary, the intermaxillary, and the extraoral types of elastics. Intramaxillary elastics, as the name implies, are used from one point on the upper or lower jaw to another point on the same jaw. Intermaxillary elastics are used from one jaw to the other. The so-called Class II elastic is used usually from a point in the upper cuspid area to a point on the lower molar area. A variation of intermaxillary elastics is the "cross-elastic" used from a labial or buccal point on one jaw to a corresponding lingual point on the opposite jaw, as from the buccal of the lower first molar to the lingual of the upper first molar. The extraoral elastic is usually connected from some point on either jaw to an appliance outside of the mouth, as from the cuspid area of the upper or lower jaw to a headgear device of some sort. The type of elastic used may vary from a very small elastic band to a wide band of cloth-reinforced rubber or a resilient plastic material. Another type of extraoral force is that type employing a chin cap connected with a headgear by elastic, flat springs, or coil springs.

The type of anchorage varies greatly with the type of appliance used. Obviously a multiband technique in which many teeth are immobilized as a unit should provide a more stable type of anchorage than a technique in which a lesser number of teeth are banded. McCoy[11] stated: "Anchorage consists in the selection of adequate and properly distributed resistance units for the control and direction of force."

However, it is not possible to generalize about the amount of necessary anchorage for much the same reason that it would be impossible to generalize about the amount of poured concrete that would be necessary to make a good foundation for a house. We would require a different amount and type of foundation if we were building on solid rock than if we were building on a swamp, or if we were building on sand, or on hard packed clay. The bony foundation of teeth varies in much the same way, since some teeth have longer roots than others and the bone which is the basic support may vary in density and strength. With our present knowledge of the supporting tissues of the teeth, we cannot be as certain about the type and strength of the foundation as an architect or engineer can be about the foundation for a house.

This analogy oversimplifies the problem. In addition to the concept of the density and the strength of the supporting tissues, it is necessary to take into consideration the growth rate with particular emphasis on the rate of

osteoclastic and osteoblastic activity. In some individuals the reaction to relatively light forces will cause tremendous resorption and subsequent redeposition of bone, causing very rapid movement of teeth.

It is quite conceivable under such circumstances that the so-called anchorage in some cases with its widely distributed, relatively light pressures could excite more bone growth and development than is found in the mouth area where active treatment is being carried on; to quote Angle,[3] "a force so gentle and so evenly distributed as to stimulate normal cellular activity and the growth of bone." Until we can evaluate better the strength and resistance of the supporting structures it will be impossible to estimate with any degree of accuracy beyond clinical judgment the stability of tooth "anchorage."

The amount of force that "anchorage" must oppose is based upon the ancient axiom that "each action has an equal and opposite reaction." Atkinson[4] stated: "It is our concern to select orthodontic appliances capable of delivering to the teeth and jaws the most nearly correct amount of controlled force capable of inciting proper cellular activity in a selected area of the anatomy of a particular individual." However, the force of four ounces that is used to move certain teeth is also exerted in an opposite manner on the teeth and supporting tissue of the anchorage. If a larger number of teeth are moved en masse, then there is a larger reaction to the amount of the force exerted. Forces as used in the mouth are not usually unidirectional forces. They are capable of being broken up into various components which resolve themselves in several directions. Before taking up the resolution of forces it is necessary to analyze the various types of anchorage-movement combinations.

The direction of force exerted and components of these forces vary, as might be expected, with each device. Owing to the mobility of the various members of the body, rarely is a colinear force used. The nearest thing to a colinear force is exerted by coil springs or intramaxillary elastics. The force exerted is perpendicular to the teeth and parallel to the direction of the desired tooth movement. The long parallel bearing surface maintained by the buccal tube aids in avoiding any torque force. However, in the use of intermaxillary elastics, forces are exerted which, to a large extent, contain components exerted in rotational directions widely divergent to the direction of the desired movement of the teeth. The sum of the components of these undesirable forces under certain conditions exceeds the desirable force. These rotational forces account, for the most part, for the tipping and opening of the bite which follows distal movement all too often.

The use of anterior supports for buccal appliances acts to absorb many of these undesired forces and to counteract the tremendous leverage imposed by the comparatively great length of the appliance posterior to the point of imposition of the force. This, of course, imposes pressures on the anterior teeth opposed to the direction in which they are designed to accept those pressures. Teeth are designed to accept direct pressure perpendicular to their long axis, more moderate transverse stresses, but not pressure operating to displace the tooth from its socket. When the undesirable displacement

forces are in equilibrium with the physiologic resistance of the tissue against displacement, no harmful movement is accomplished. The total of the root area resisting displacement is usually very great because of the wide area encompassed by the root anchorage. Direct pressure and transverse pressures are largely supported by the bone and cushioned by the transverse fibers of the periodontal membrane. The displacement pressure must, in the case of the anterior teeth, be supported by the periodontal fibers, in many cases leading to a thickened membrane. A poorly designed extraoral appliance can have the same effect, and perhaps cause even more damage where excessive misdirected forces are applied. Since the use of occipital anchorage was introduced by Dr. Kingsley,[9] there have been many attempts to redirect and translate the force by use of traction bars. Although it was poorly designed by present standards largely because of the tremendous advances in metallurgical research which gave to orthodontics the great elasticity and strength of modern nickel-chrome-steel alloys, Dr. Edward H. Angle[2] in 1889 presented orthodontics with a traction bar, which, while not as comfortable for the patient to use as some of those in use more recently, is basically from the point of view of application of properly directioned force, as soundly designed as any in present use. Angle[3] recognized the shortcomings of his traction bar in his statement that ". . . this appliance has been superseded in the author's practice and though it may occasionally be used as auxiliary to intermaxillary anchorage, yet the necessity for its use will become lessened as greater skill in the employment of intermaxillary anchorage is developed." He apparently did not foresee the possibility for advances in the use of extraoral anchorage.

The use of the headcap provides the orthodontist with a method of stable anchorage without the necessity for using the teeth in the opposing jaw. The use of the headcap as anchorage obviates the necessity for the use of the teeth as anchorage, thereby protecting them from unnecessary traumatization. The major requirements in the use of the headcap are:

1. Proper transmission of force along the plane of movement of the teeth to avoid tipping of the teeth carrying the bands holding the labial appliance.
2. Comfort, so that bad sleeping habits are not established.
3. Simplicity, so that the patient uses the appliance with a minimum of error and inconvenience.

The distal movement of teeth with the use of a headcap is not a difficult operation. The amount of movement can be measured very accurately by the use of the key ridge plane on gnathostatic models.[5] In cases of bimaxillary protrusion, it provides virtually the only safe method for distal movement without resorting to the extraction of four or more teeth.

The use of a spring traction bar for transmission of force to the arch from the elastics anchored to the headgear fulfills all three conditions. The design of the spring in the traction bar permits the transmission of force in virtually any useful plane without an unfavorable component of force being exerted on the appliance (Fig. 6). Application of the appliance is no more complicated than the use of intermaxillary elastics. The force exerted must

be measured very carefully since it is all too easy to apply excessive pressure. Since there is no appreciable bulk or any joints or protruding bands in the traction bar, patients find it as comfortable to sleep with as one might reasonably expect. It is well to check the amount of distal movement frequently by use of the key ridge plane. A frequent and accurate check can easily be made by use of a key ridge index or recorder.[5]

In most cases, owing to the transmission of force along the proper occlusal plane by manipulation of the ends of the traction bar, it is unnecessary to use the conventional headgear involving the use of the whole occiput as anchorage. The use of a simple neckband seems sufficient in most cases. In order that maximum equalizing pressure be exerted, the use of 0.030 nickel-chrome-alloy wire was found to be most satisfactory for use as a spring traction bar. Cotton twill tape approximately 1 to 1¼ inches wide, used for binding rugs, seems to be very satisfactory for neckbands and headgear. Intermaxillary elastics of the proper size are used to connect the spring traction bars with the head or neck gear.

The characteristics of a force are that it has magnitude, place of application, and direction. The magnitude of the forces applied in the mouth by intermaxillary elastics for the movement of teeth is relatively low by present-day standards, compared with earlier practices. The force exerted by the intermaxillary elastic is capable of being resolved into several components, most of which are not useful or desirable. The useful component of this force is even less than would appear at first glance. (See Figs. 1-7.) In distal movement of upper teeth, a concentrated force is generally applied at a hook on the upper appliance in the cuspid area, with the line of action against the molar teeth, where the force becomes "distributed." The other place of application is the anchorage which may be either intraoral or extraoral. In any case the attempt is made to make all mouth anchorage forces "distributed forces"—over as broad an area as possible; i.e., that the place of application be very small compared to the tooth area to which it is applied. The unimportance of the point on the anchorage area to which the force or elastic band is applied is expressed in the "principle of transmissibility of force" which may be stated as follows[10]: "The effect of any force applied to a rigid body at rest is the same, no matter where in its own line of action the force is applied." An attempt is made for the anchorage and the force applied to be a "balanced system," i.e., that the load of the rubber band not be greater than the ability of the teeth used as anchorage to support that load.

The direction of force is most complicated since the center of rotation of a tooth varies with the load applied to it.

To quote Aisenberg[1]:

> Both the orthodontist and the periodontist have benefited from experimental research concerning the effect of these stresses directed against teeth. It is here that we enter into the controversy of the location of the fulcrum[13] of a tooth. When a tooth is tipped by a horizontal stress, the fulcrum is described as being just below the center of the alveolus. When a strong force is used, this holds true. When light forces are used, the fulcrum is said to appear more apical.[12]

Since the magnitude of the force depends on the length of the roots and the position of the center of rotation or fulcrum, the forces are, of necessity, approximate, and the entire picture presented is one of proportional forces. No good purpose would be served in presenting a statistical study since the factors involved would vary and the analysis would not present a clear picture. Any specific set of figures can be used with this method and a proportion of useful to deleterious forces can be set up. The reason why no values were assigned to the arrows in the space diagrams was because a different set of values could be determined for each degree of mouth opening, strength of elastic, degree of tooth rotation, and elasticity of arch body wires. The vector diagrams represent empirical values and angles.

The action of a simple elastic band in Fig. 1 has many wide and divergent effects. The only useful component of force resulting from elastic tension from the hook on the labial arch to the buccal tube on the lower first molar is exerted in a distal direction perpendicular to the long axis of the upper first molar. There are many displacement forces.

The displacement forces developed by intermaxillary elastics in the upper molar are very great as indicated in the space and vector diagrams, Fig. 1 through 7. They are of two types. There is a direct downward displacement force exerted in an occlusal direction. There is also a rotational force set up. The sum of the displacement forces exceeds the useful horizontal distal force.

In addition to the forces exerted on the upper molar, of which there is one useful component, there are equal and opposite forces exerted on the lower teeth which have no useful components. There are rotational, mesial, and upward displacement forces exerted on the lower banded molar. There is a rotational force exerted on the lower anterior teeth against which the lower lingual rests.

With all these divergent displacement forces, the teeth should readily be exfoliated and certainly not move in the directions they are expected to. Fortunately the problem is not wholly an engineering problem involving the use of mud, sand, and wood, but a biologic problem where many other factors are involved. Where the pressures are within physiologic limits, the response of the tissues negates the dire results indicated by the vector diagram. Where, however, excessive forces are used, the vector diagrams present a true indication of the distribution of the forces, explain the destruction which follows the insertion of poorly designed and poorly planned appliances and "therapy." In a case where a lower lingual appliance is used as anchorage and is not properly made, so that the entire appliance rests on soft tissues, the effects of the upward displacement and rotational forces are as shown in the space and vector diagrams. In a case where excessive elastic pressure was used, with perhaps no lingual stabilizing appliance and no support for the anterior portion of the labial arch, the rotational figures for the upper first molar are all too true.

ANALYSIS OF SPACE AND VECTOR DIAGRAMS

Fig. 1 illustrates a space diagram of the right side of a mouth in which a typical appliance was constructed for the use of Class II elastics. Schwartz's[14]

figures for average tooth lengths and widths were used on the scale drawings of the upper and lower first molar and lower central incisor. The average length of the upper first molar used was 20.8 mm. The average crown length was 7.7 mm., and root length, 13.1 mm.

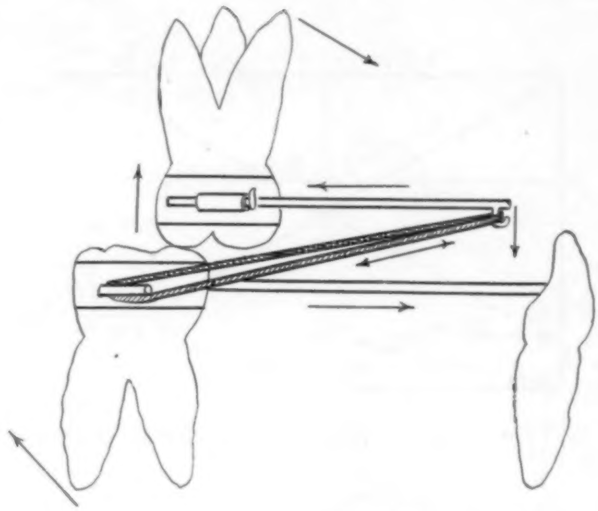

Fig. 1.—Space diagram: intermaxillary elastics; mouth closed.

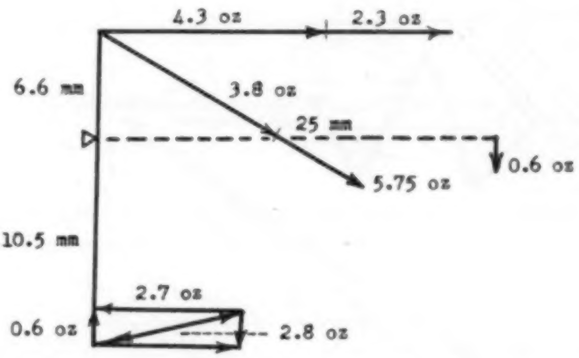

Fig. 2.—Vector diagram: intermaxillary elastics; mouth closed.

The length of the buccal appliance from intermaxillary hook to the buccal tube was empirically determined to be 25 mm. The intermaxillary elastic tension was chosen with great care. A scale drawing was constructed of the open mouth and closed mouth positions. An elastic band was chosen which exerted a tension of exactly 4.0 ounces when stretched between the lower buccal tube and the upper intermaxillary hook on the drawing of the open mouth position. The same elastic band was then stretched between the lower buccal tube and the upper intermaxillary hook in the closed mouth position. The tension was found to be 2.8 ounces. This tension was then used for the calibrations in Fig. 2. The elastic tensions in Figs. 3, 5, and 7 are all 4.0 ounces.

The space diagrams, Figs. 1, 4, and 6, show no figures although they were drawn to scale.

However, arrows showing the tension of the elastic and the components of force were inserted. The forces in Figs. 2, 3, 5, and 7 can be inserted over the arrows for the tension and proportions of appliance which are used in this paper, or for amounts representing any other elastic tensions. Appliance and tooth lengths may be inserted at the convenience of the reader.

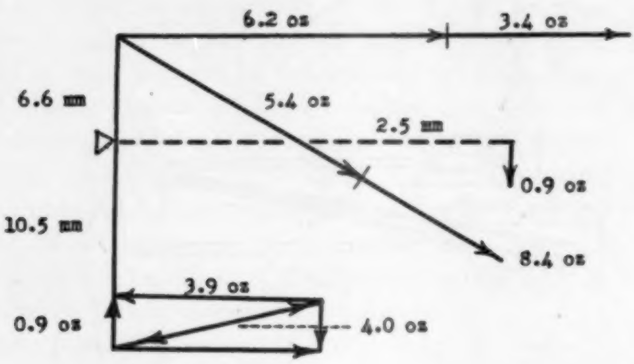

Fig. 3.—Vector diagram: intermaxillary elastics; mouth closed.

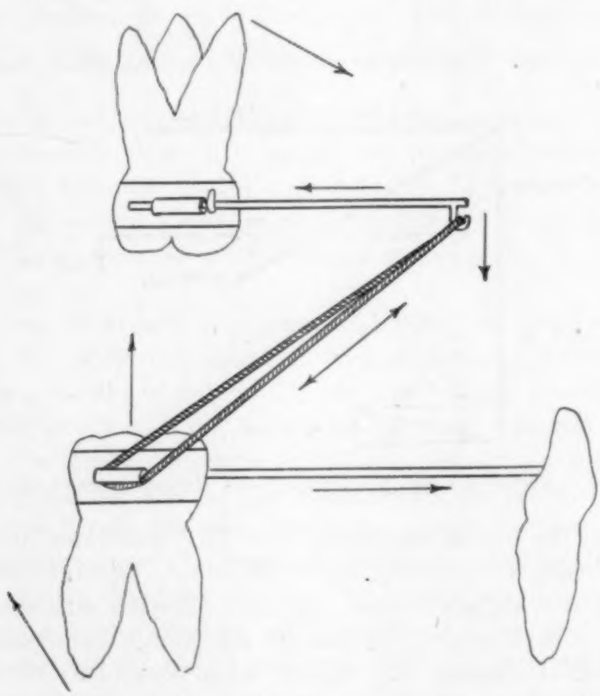

Fig. 4.—Space diagram: intermaxillary elastics; mouth open.

In order to determine the components of the elastic tension of 2.8 ounces in Fig. 2, a force parallelogram was made. The downward component of 0.6 ounce and distal component of 2.7 ounces are components of the force exerted at the upper intermaxillary hook (Fig. 1). This distal component of 2.7 ounces is the only useful force component exerted by the elastic.

The upward component of 0.6 ounce and mesial component of 2.7 ounces are components of the force exerted at the lower buccal tube (Fig. 1). The upward arrow drawn from the crown of the lower molar and alongside of the

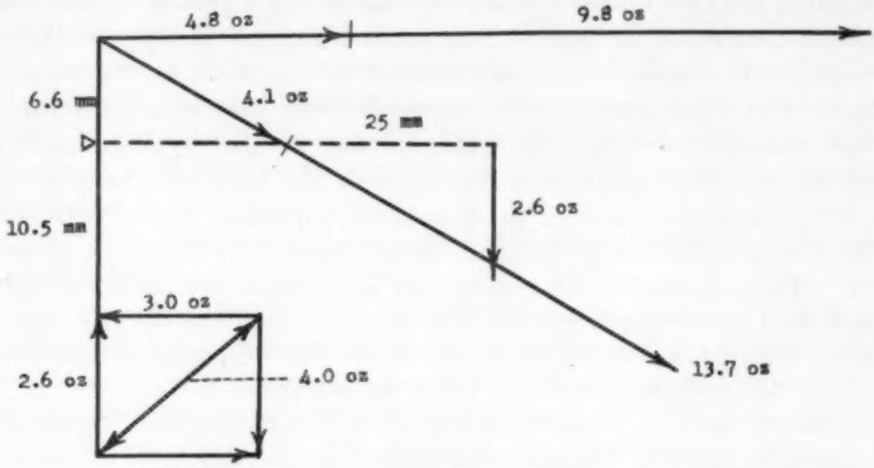

Fig. 5.—Vector diagram: intermaxillary elastics; mouth open.

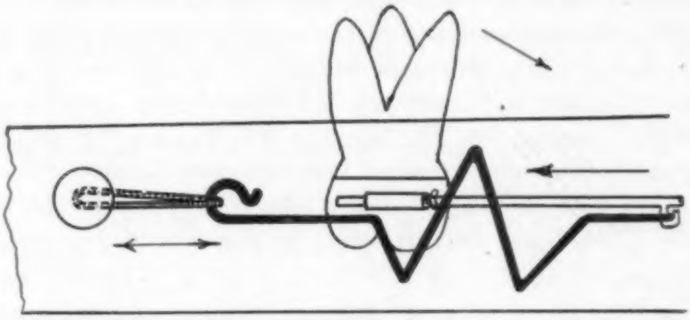

Fig. 6.—Space diagram: headgear with spring traction bar.

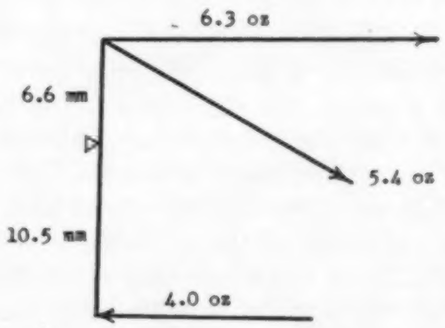

Fig. 7.—Vector diagram: headgear with spring traction bar.

upper molar in Fig. 1 demonstrates that the upward force is transmitted through both teeth in the closed mouth position.

In order to determine the rotational forces at the apex of the upper molar, the distal force of 2.7 ounces is multiplied by the length of the tooth from the

upper buccal tube to the center of rotation, 10.5 mm., and divided by the length root from the center of rotation to the apex, 6.6 mm. This will give a force of 4.3 ounces acting in an opposite direction to the distal force of 2.7 ounces, fulfilling the law that the sum of forces in any direction equals zero. The downward component of force at the hook, 0.6 ounce, is then multiplied by the length of the upper buccal appliance from the hook to the point of attachment of the upper buccal tube, 25 mm. Since this torque force acts through the center of rotation, this figure is then divided by the length of roots from the center of rotation to the apex of the tooth. A force of 2.3 ounces is found to act at the apex in an opposite direction to the downward force of 0.6 ounce at the hook, fulfilling the law that the sum of the torques equals zero. These forces, of 4.3 ounces and 2.3 ounces, are then added together since they are acting together from the same point in the same direction. A force triangle is then set up at the apex. The 30° component of force of 6.6 ounces at the apex is found to be a rotational force of 5.75 ounces.

The rotational force at the apex of the lower first molar, since it contains no torque force, is found by the same mathematical reasoning to be 3.8 ounces.

TABLE I. COMPONENTS OF FORCES USED TO EFFECT DISTAL MOVEMENT OF UPPER TEETH

			UNDESIRABLE COMPONENTS OF FORCE				
	ELASTIC TENSION APPLIED	USEFUL DISTAL DRIVING COMPONENT	MESIAL—LOWER MOLAR	ROTATIONAL—LOWER ROOT ENDS	UPWARD—LOWER MOLAR	DOWNWARD—AT INTERMAXILLARY HOOK	ROTATIONAL—UPPER ROOT ENDS
Intermaxillary elastics	2.8 oz.	2.7 oz.	2.7 oz.	3.8 oz.	0.6 oz.	0.6 oz.	5.75 oz.
Mouth closed	4.0 oz.	3.9 oz.	3.9 oz.	5.4 oz.	0.9 oz.	0.9 oz.	8.4 oz.
Intermaxillary elastics Mouth open	4.0 oz.	3.0 oz.	3.0 oz.	4.1 oz.	2.6 oz.	2.6 oz.	13.7 oz.
Headgear with spring traction bar	4.0 oz.	4.0 oz.	None	None	None	None	5.46 oz.

The same procedure is followed out in the analysis of vector diagrams, Figs. 3 and 5. Fig. 6 represents a space diagram showing a portion of a headgear or neckband in place on the right side of the face with an elastic band exerting tension on a spring traction bar which is connected to the buccal hook on the upper buccal appliance. Since the line of action is parallel with the appliance, the pressure exerted on the buccal hook is 4.0 ounces (Fig. 7). In addition to the distal action of the appliance of 4.0 ounces, there is a rotational force. The distal force of 4.0 ounces is multiplied by the combined crown and root length from the point of attachment of the upper buccal tube to the center of rotation of the tooth, 10.5 mm., and divided by the root length from the center of rotation to the apex, 6.6 mm. A force of 6.3 ounces is found to be acting at the root end in an opposite direction to the distal force of 4.0 ounces. A force triangle shows the rotational force at 30° to be 5.4 ounces.

Table I shows the elastic tension, the useful component, and the displacement forces.

FORMULAE FOR ROTATIONAL FORCES AT ROOT APICES

1. Upper molars: Distal force X the length of the tooth from the attachment of the buccal tube to the center of rotation of the tooth ÷ by the length of the tooth from the center of rotation of the tooth to the apex = F_1 acting in a mesial direction at the apex.

Downward force at the intermaxillary hook X the length of the upper buccal appliance wire from the intermaxillary hook to the point of attachment of the buccal tube to the upper molar band ÷ by the length of the tooth from the center of rotation of the tooth to the apex = F_2 acting in a mesial direction at the apex.

$F_1 + F_2$ = the total force acting in a mesial direction at the apex of the upper molar.

2. Lower molars: Mesial force X the length of the tooth from the attachment of the buccal tube to the center of rotation of the tooth ÷ by the length of the tooth from the center of rotation of the tooth at the apex = F acting in a distal direction at the apex of the lower molar.

SUMMARY OF RESULTS

In the application of an intermaxillary elastic tension of 2.8 ounces in the closed mouth, there is found to be a useful distal component of 2.7 ounces, approximately a 4 per cent loss. Elastic strength of 4.0 ounces in the closed mouth position, open mouth position, and with the headgear shows a distal driving force of 3.9 ounces, 3.0 ounces, and 4.0 ounces, respectively, with losses of 2.5 per cent, 25 per cent, and 0 per cent, approximately. From the point of view of efficiency, it would appear that there is very little to choose between the use of intermaxillary elastics with the mouth closed and the headgear.

However, when the undesirable displacement forces are analyzed, there appears to be an enormous difference in efficiency. In the use of the headgear, there is no mesial driving force acting on the lower first molar. The mesial driving force on the lower first molar with the use of intermaxillary elastics is exactly the amount of the distal driving force on the upper first molar, i.e., 2.7 ounces, 3.9 ounces, and 3.0 ounces.

These, however, are not the only deleterious forces acting on the lower molar. There is an upward displacement force tending to remove the tooth from its socket of 2.6 ounces when the mouth is open against a tension of 4.0 ounces of intermaxillary elastic. Even the most excellent anchorage with a lingual appliance cannot check this force.

With the mouth closed, only 0.6 ounce is exerted with a 2.8 ounce elastic, and 0.9 ounce with a 4.0 ounce elastic. With the headgear there is, of course, no upward force on the lower first molar.

There is also a rotational force at the apex of the lower roots. Since this force has a direct relationship to the mesial driving force, we find that the most efficient forces exert the greatest rotational effect on the lower first molar. The intermaxillary elastics of 2.8 ounces and of 4.0 ounces with the mouth

closed exert rotational forces of 3.8 ounces and 5.4 ounces, respectively. The intermaxillary elastic force of 4.0 ounces with the mouth open exerts 4.1 ounces of rotational force against the lower first molar. These forces are effective, of course, only to the degree to which the mandibular anchorage fails to distribute them. With the headgear, there is obviously no rotational force on the lower molar.

The deleterious forces acting on the upper molar are a downward displacement force transmitted through the upper appliance from the hook and a rotational force at the root ends. The downward pressure is 0.6 ounce and 0.9 ounce for intermaxillary elastics of 2.8 ounces and 4.0 ounces, respectively, with the mouth closed. This is antagonistic to the upward pressure on the lower first molar of corresponding magnitudes, and when the mouth is closed they negate one another. The downward pull is 2.6 ounces for an elastic tension of 4.0 ounces when the mouth is open. There is no protection against this force except in a multiband technique where it becomes distributed in relation to the number of teeth banded. There is no downward pressure with a headgear unless the headgear or traction bar is improperly designed.

The rotational force at the upper root ends is present with all appliances. It can be minimized only when very light pressures are used. For intermaxillary elastics, mouth closed, with pressures of 2.8 ounces and 4.0 ounces, the rotational forces at the root ends are 5.75 ounces and 8.4 ounces. For an intermaxillary pressure of 4.0 ounces with the mouth open, there is a rotational force of 13.7 ounces. This force of 4.0 ounces is multiplied almost 350 per cent by the various leverages involved. The rotational force on the upper first molar when a headgear is used with a traction force of 4.0 ounces is 5.46 ounces.

CONCLUSIONS

1. The deleterious forces exerted are greater than the useful distal driving component of force in the distal movement of teeth.

2. The headgear with spring traction bar exerts the smallest amount of undesirable components.

3. The most favorable combination of forces for the distal movement of teeth would be the use of minimal intermaxillary elastic pressures during the day when the mouth opens frequently and the use of heavier intermaxillary elastics and/or a headgear with a spring traction bar during sleeping, television, and reading hours.

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VERTICAL DIMENSION

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THE influence of orthodontic therapy in changing the vertical dimension of the face is the theme of this paper. This subject has been written upon many times in the past, and invariably the use of the bite plate, in deep overbite cases, is advocated at different stages or periods of treatment. Some orthodontists recommend the use of the bite plate before conventional treatment is instituted, others during treatment, and still others during retention only.

There are two types of bite planes employed in the construction of most bite plates: the flat plane and the steep, or inclined, plane. When the flat type is used the incisal edges of the lower anterior teeth strike the flat plane first, in this way taking the posterior teeth out of occlusion. The mandible is thus free to seek a position that is in harmony with its controlling musculature, no attempt being made mechanically to influence its position. In contrast, the inclined plane type is constructed so as to engage the incisal edges and parts of the lingual surfaces of the lower incisor teeth, thus forcing the mandible to occlude in a forward position.

Kingsley is generally credited with having popularized the use of the inclined plane type of bite plane, using it to "jump the bite" in an effort to correct mesiodistal relationship. There are some orthodontists at the present time who, in effect, employ a technique similar to that advocated by Kingsley, using a fixed-removable maxillary appliance to reposition the mandible forward.

Carey[1] and others advocate the insertion of a flat bite plate at the time that intermaxillary elastics are being worn to take the opposing teeth out of occlusion. Most of the inclined plane interference of the cusps of the teeth is thus eliminated during the correction of the mesiodistal relationship.

Among the more important indications for the bite plate in treatment are:

1. Deep overbite.
2. Posterior mandibular displacement.
3. Lateral mandibular displacement.
4. Bilateral and anterior cross-bites.
5. Difficulty in banding certain mandibular teeth because of occlusion with the maxillary teeth.

The individual with a closed bite and displacement, if one exists, should be studied carefully with casts, photographs, and head films when available.

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In addition a clinical examination should be made of the patient himself. Observation of the individual with the teeth in occlusion, in physiologic rest position, and, finally, in chewing will reveal certain data which can be obtained in no other manner. When a posterior mandibular displacement is present, photographs taken with the teeth in centric occlusion will more often than not show pouting lips, strained musculature, and a deepened labiomental sulcus. Photographs taken of the same patient at the same time with the mandible in physiologic rest position will demonstrate a much improved appearance of the face when compared with those taken in centric occlusion. Musculature is no longer strained and the profile assumes the appearance of an acceptable aftertreatment photograph.

The value of studying the patient, his photographs and head film tracings of centric and rest position, has been pointed out by Thompson.[2] Accepting the information gained by observing teeth in centric occlusion is only half of the story. It is a most valuable aid in treatment planning and prognosis to determine whether or not one is treating a patient whose mandible is being forced into a distal relationship upon closing, by the incline plane relationship of the teeth. Thompson[2] referred to these observations as "functional analysis," and stated, "This method of analysis is referred to as the functional analysis of occlusion and is offered not as a substitute, but only as a supplement of the generally accepted methods in use today."

In a treatise on this subject, Wylie[3] discussed the lack of vertical height in orthodontic patients as compared to the general population, concluding that:

1. "The vertical dimension of orthodontic patients with the teeth in occlusion is, on the average, less than that of the general population."
2. "This relative deficiency of vertical dimension in orthodontic patients obtained not only when the jaws are closed, but in physiologic rest position as well."
3. "Individual for individual there is a high degree of correlation between the vertical height in occlusion and the vertical height at rest."
4. "It is suggested that in the majority of individuals the amount of vertical development in the buccal segments is determined largely by the jaw relationships as dictated by the musculature, but that in some cases the full amount of vertical development permitted by the musculature is not attained. These latter cases offer the best prognosis for orthodontic and reconstructive procedures."

How much added vertical development should the orthodontic patient have; in other words, how much should the bite be opened? Thompson[4] warned us of the danger of opening the bite beyond physiologic rest position. He cited cases in which resorption of the alveolar bone took place when prosthetic appliances which exceeded normal physiologic rest position were placed in the mouth. Undoubtedly, this applies to orthodontic patients as well. Pain and loosening of the anterior teeth are likely results when the bite is opened too greatly in orthodontic patients. Thompson's[4] warning is very timely since

there is an accurate method of gauging this amount. Repeatedly observing the patient's teeth with the mandible at rest following the act of swallowing will give a relatively accurate gauge of the interocclusal clearance or freeway space when the mandible is suspended at rest.

So many of our patients present themselves with closed bites that it poses a problem which deserves our close attention. It would seem not only reasonable but also logical that this step in our corrective procedure be given primary consideration. Lack of optimum vertical eruption of the buccal teeth of both the maxilla and the mandible is characteristic of closed bite malocclusions. Early correction of this condition is started with the insertion of the bite plate. Tweed[5] believes and teaches that the preparation of the mandibular teeth for anchorage must be given early consideration in the rationale of treatment planning. Much of this can be started and accomplished during the initial period when the bite plate is being worn.

THE BITE PLATE AS AN ADJUNCT TO ORTHODONTIC THERAPY

Nonextraction Cases.—If analysis of the case reveals that extraction is not indicated, but there exists a deep overbite with the lower incisors biting into the soft tissues of the palate, a bite plate is generally warranted in the maxillary arch. In such cases, if the teeth are banded before the impression is taken for the bite plate, small spurs of stainless steel wire mesial to the canines, or mesial to the first premolars, and either mesial or distal to the last molar, assist in holding the appliance quite securely in the mouth. I have found that small round steel wires of 0.026 inch, or larger, running either mesially or distally to the last banded molar and bent around to the buccal surface to lie gingivally over the buccal tubes, not only assist in holding the plate in place, but also add to the ease with which it may be removed by the patient for cleaning. When the upper incisors are not banded, a labial bow, such as is used on retainers, is often effective in stabilizing this appliance in the mouth.

In those cases in which it is not desirable to band all the upper teeth before making and inserting the bite plate, molars alone may be banded and either mesial or distal wires used over the buccal tubes. In case the molars are left unbanded, stainless steel wire clasps around several teeth may be used for retention. The use of a modified Crozat Crib* has been found to be successful as a retentive agent on the molars.

An accurate alignate impression of the upper arch is taken, being sure to include all of the teeth and soft tissues to be covered by the appliance. The impression is then poured, preferably in stone, and when separated, the outline of the appliance and the position of the wires are sketched on the model with pencil. From a study of the physiologic rest position of the patient, as discussed previously, the amount of opening that can be tolerated is determined. The depth or the extent that the flat plane should be carried distally can also be determined by the occlusion of the record models; obviously the

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plane must be such that the lower incisors cannot strike behind it. If one finds the plane deeper than necessary when placed in the mouth, it can easily be adjusted. The appliance is then processed in acrylic. It is quite generally agreed among those who have used this type of appliance that, with one possible exception, the plane itself should be flat in order to prevent any unnecessary labial tipping of the lower incisor teeth.

The lower incisors in certain Class II, Division 2 cases stand almost vertical or may even have been forced into a distal axial inclination from the lingual position of the crowns of the upper central incisors. It is believed in this type of case a steep bite plane is of advantage, providing a posterior displacement is present. The steep incline of the bite plane may have some beneficial effect on the crowded distally inclined mandibular incisors; otherwise a flat plane for the incisors to occlude with is advisable.

It is usually necessary to do some adjusting when first placing the appliance; lingual spurs must be cut short to fit the teeth, and clasps bent more snugly so that the plate will not rock or be displaced during the act of chewing. A small amount of grinding of the plane is also necessary. All four lower incisors, and sometimes the cuspids as well, should occlude with the plane when the patient bites. It is important to distribute the load quite equally upon all lower anterior teeth. The posterior teeth are thus taken out of occlusion.

The patient should then be instructed how to insert and remove the appliance, and how and when to clean it. A denture brush with soap and water used at least twice daily is an excellent way of keeping the appliance thoroughly clean. Instructions are also given in how to clean the mouth and teeth, and then the patient is dismissed with instructions to wear the appliance constantly, and to eat with it in during all meals. The patient generally reports a little difficulty in chewing during the first meal or two, but after that he reports he is more comfortable with the appliance in place than without it.

After two or three weeks of faithfully wearing the appliance it will be noticed that the lower incisors no longer strike against the soft tissues of the upper incisors when the appliance is removed. They have the appearance of having been depressed one or more millimeters. It has been found by serial cephalometric x-ray studies carried on at several universities, and by studies being conducted at the present time in the Department of Orthodontics at the University of Washington, that the mandibular incisors are permanently depressed very little if at all. There is instead an apparent eruption of the posterior teeth and growth of the alveolar structures in both the maxilla and mandible.

Extraction Cases.—Malocclusions in which teeth must be removed in order to effect a stable and esthetic end result call for an exacting and careful technique in the closure of spaces. The majority of these cases present varying degrees of overbite, ranging from slight to the very deep, and many times with some posterior mandibular displacement. The maxillary removable appliance not only assists in the correction of the deep overbite but also is very effective in the partial closing of the extraction spaces in the maxillary arch.

If first premolars have been selected as the teeth to be extracted, it is wise to wait a week or ten days after their removal before taking an impression for the construction of the removable appliance, thus insuring more accurate tissue adaption. A stone model is then made from the alignate impression as was outlined previously.

It is equally important now, when teeth have been removed, to have the appliance stable when placed in the mouth. I prefer to place bands on either the upper first or second molars, depending upon the treatment plan. The bands and tubes are reproduced in the stone model. Sketch on the model in pencil the outline of the appliance, indicating the desired position of the wires, the amount of soft tissue to be covered by the acrylic, and the height and depth of the bite plane.

If the twelve-year molars are banded, round stainless steel wires of 0.026 inch, 0.028 inch, or 0.030 inch are bent to fit around the mesial or distal surface of the banded teeth, the free ends lying gingivally to the buccal tubes and the other ends adapted to the palate to be imbedded in the acrylic. The same procedure is followed if the six-year molars are banded instead of the twelve-year molars.

Second premolars are prevented from drifting forward by placing 0.026 inch round stainless steel stops or clasps mesial to them (Fig. 1). Round 0.026 inch stainless steel wires are bent anteriorly to the cuspids with the free ends recurving down to their mesial surfaces to form springs to guide these teeth distally. The free ends of these recurved springs are cut and bent to rest on the mesial or mesiolabial surfaces of the cuspids (Fig. 2). Occasionally a labial bow may be used effectively around protruding incisors for added stability.

After trimming and polishing, the appliance is tried in the patient's mouth. A certain amount of shortening and reshaping of the wires is necessary. The free ends of the recurved springs lying mesial to the cuspids are bent to rest on the proper area of the mesial surfaces of the cuspids. It is wise not to activate these springs when first placing the appliance.

When the appliance has been made to fit securely and comfortably in the mouth, the acrylic lingual and distal to the cuspids is ground away so as to free entirely these two teeth. The only part of the appliance touching the cuspids is the free ends of the recurved springs.

Attention is next directed to the bite plane. Check its height and depth and note whether the lower incisors are still occluding on the plane when the mandible is in its most retrusive position. If they do not, the depth should be increased until this is corrected. This can be accomplished quickly by adding one of the quick curing acrylic resins to the bite plate. In like manner the height of the plane can be increased at this time, or later, if found necessary.

The posterior teeth are now free of occlusion to an amount not exceeding the physiologic rest position. Articulating paper will show where the plane should be ground for individual teeth so as to produce occlusion with at least

all four lower incisors. The patient is going to wear this appliance for some time, eating with it during all meals, so it should be made as comfortable as possible. No attempt should be made to activate the cuspid springs until the second appointment, and then only slightly. It will take but a small amount of pressure to move these teeth distally a considerable amount.

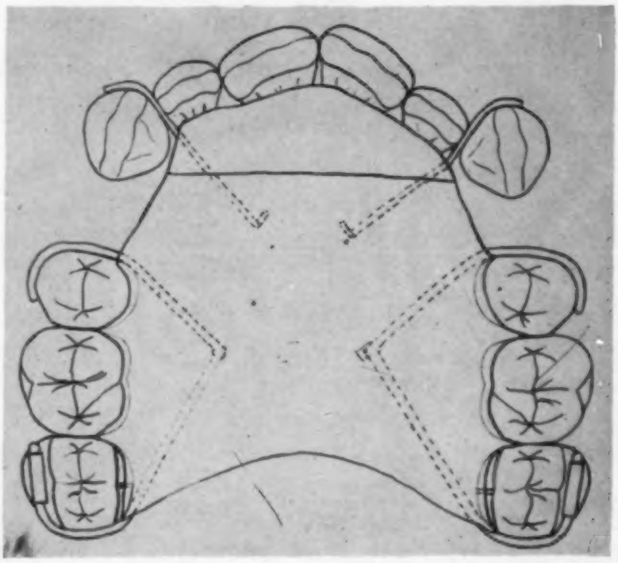


Fig. 1.

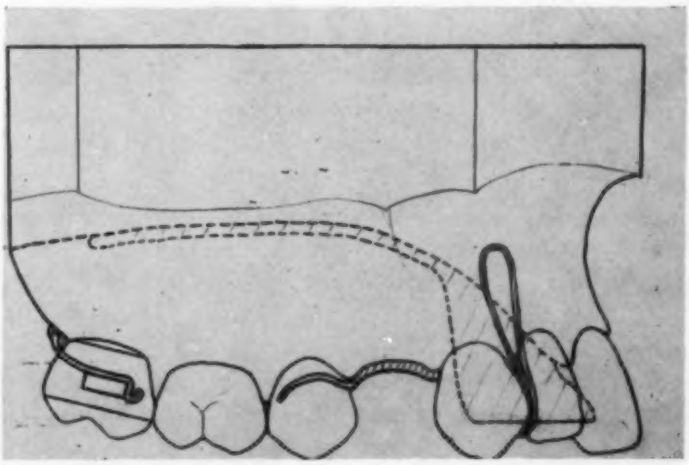


Fig. 2.

As was explained previously, the patient is instructed how to insert and remove the appliance. If it is accurately made and adjusted, it fits so snugly that the patient experiences little or no difficulty in talking or eating with it in place. A few moments' practice in talking slowly is all that is necessary for one to become accustomed to speaking with it.

Increased vertical dimension is obtained by eruption of the posterior teeth and the growth of the alveolar processes. This can be started early in treatment through the intelligent use of the bite plate. The appliance may be placed very early in treatment and without the necessity of banding all of the maxillary teeth. When it is necessary to remove premolars, the cuspids can be guided distally by the recurved springs from the bite plate more rapidly and physiologically than with the conventional bands and arch wires.

Cooperation.—Growth and eruption are made possible in cases of deep overbite by the faithful wearing of the removable appliance, and cooperation by the patient is essential for desired results. *If the lower incisors do not have the appearance of being depressed one can safely assume that there has been poor cooperation.* I never tell the patient how I know that the appliance is not being worn. Patients seem mystified as to how one can be so sure. A call to the mother and father generally is all that is necessary to insure necessary help.

General Consideration.—The question may be logically asked, "When should the maxillary appliance be discarded?" In nonextraction cases it is generally worn until the posterior teeth, that were originally separated, have erupted into occlusion and have remained in function for some time with the bite plate in place. Most generally anchorage preparation is under way in the lower arch and it is a safe rule to keep the maxillary appliance in place until the mandibular teeth are all banded, especially the cuspids and incisors. The stability of the four incisors and possibly also the cuspids helps to maintain the new vertical growth of the posterior teeth.

The same rule applies in extraction cases. The removable appliance is most successfully used if left in place until the mandibular incisors have been banded. In extraction cases the mandibular cuspids will have been carried back to their relatively correct positions during the time the maxillary appliance has been worn. The four lower incisors will be spaced and can be banded easily before the removal of the bite plate. Banding of the teeth in the maxillary arch is now begun.

The following paragraphs illustrate the results obtained in malocclusions in which a bite plate was used.

Fig. 3 shows the right, front and left views of a patient before treatment. The three lower views are the same case after four and one-half months of wearing the bite plate. It is evident, when viewing the progress models from the front, that the bite has been opened. From the side there is also evidence of an increase in vertical height, both in molar and premolar eruption.

The maxillary canines have been carried back to a vertical axial inclination by the recurved springs from the bite plate, partially closing the premolar extraction spaces and creating more space for the incisors.

The four mandibular incisors and canines were extremely bunched so a lingual appliance was placed with stops soldered mesial to the second premolars, preventing these teeth from drifting forward. The canines drifted distally, relieving the crowding of the incisors and making the banding of the mandibular canines a much simpler procedure.

The molar and premolar occlusal relationship appeared to have remained relatively static when the original and progress cases were studied.

Fig. 3.

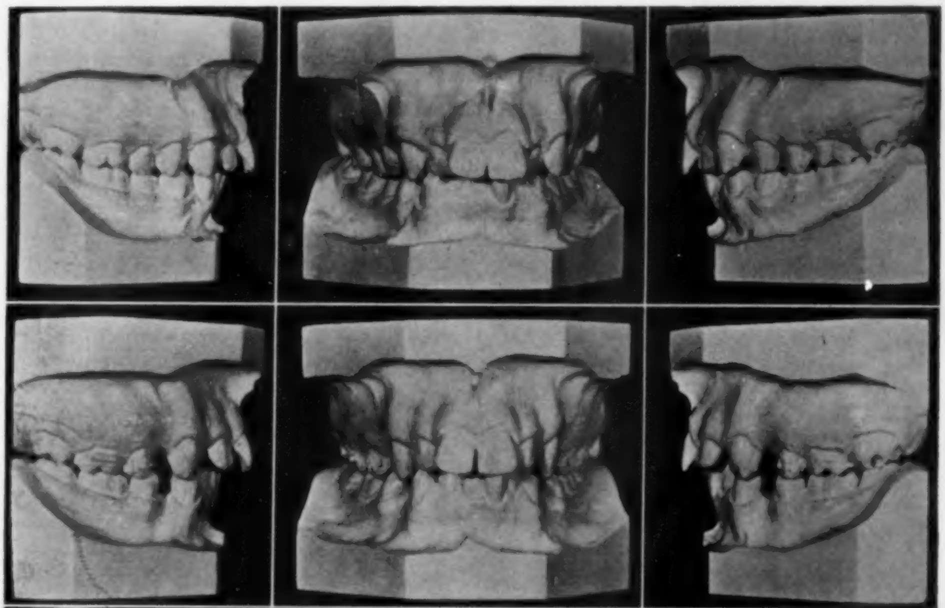
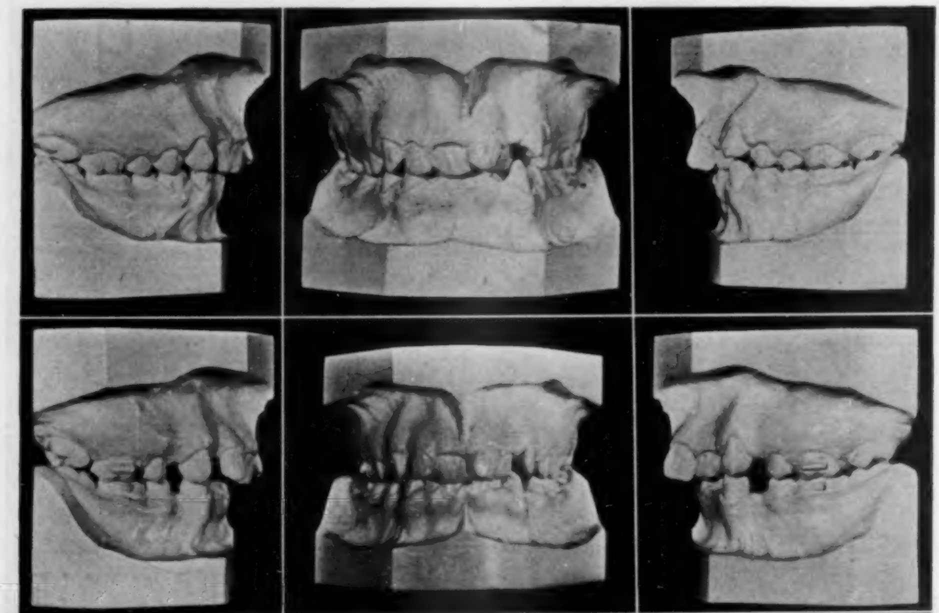


Fig. 4.

Fig. 4 illustrates a bimaxillary protrusion case. The progress models were taken five months after treatment started and show that the bite has been opened considerably from wearing the bite plate. The molar and premolar relationship appears to be essentially the same as that of the original casts.

The maxillary canines were back to a vertical axial inclination, allowing the four incisors to space. The excessive curve of Spee in the mandibular arch was being corrected and there appeared to be some vertical height occurring in the buccal segments. This case was being treated in the Clinic at

Fig. 5.



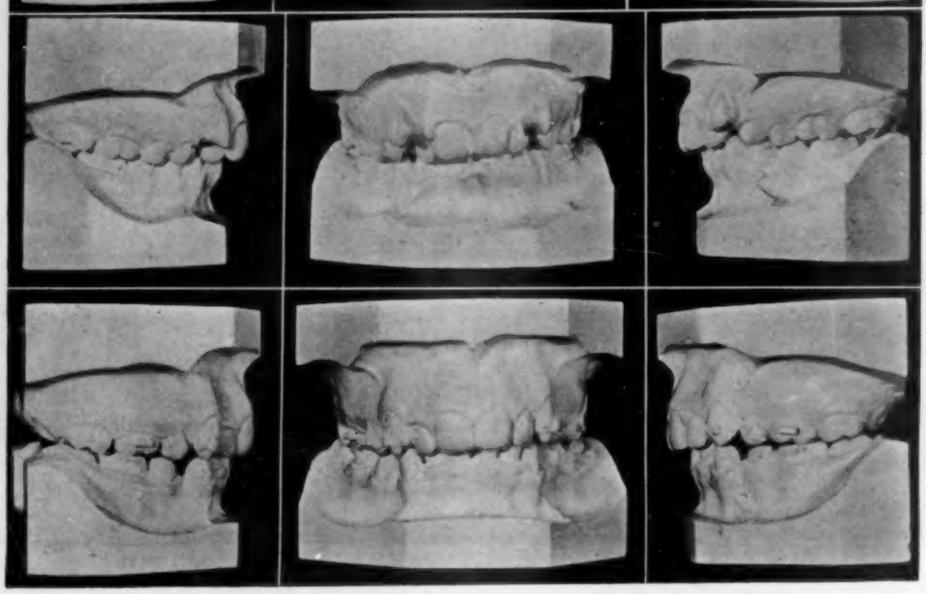


Fig. 6.

the University of Washington, School of Dentistry, Department of Orthodontics.

Fig. 5 shows models of a boy of 16 whose maxillary and mandibular incisors were extremely crowded. The progress models show the development

after four months of wearing a bite plate. Viewed from the front and the sides, there appeared to have been some vertical development despite poor co-operation from the patient. The molar and premolar relationship held very

Fig. 7.

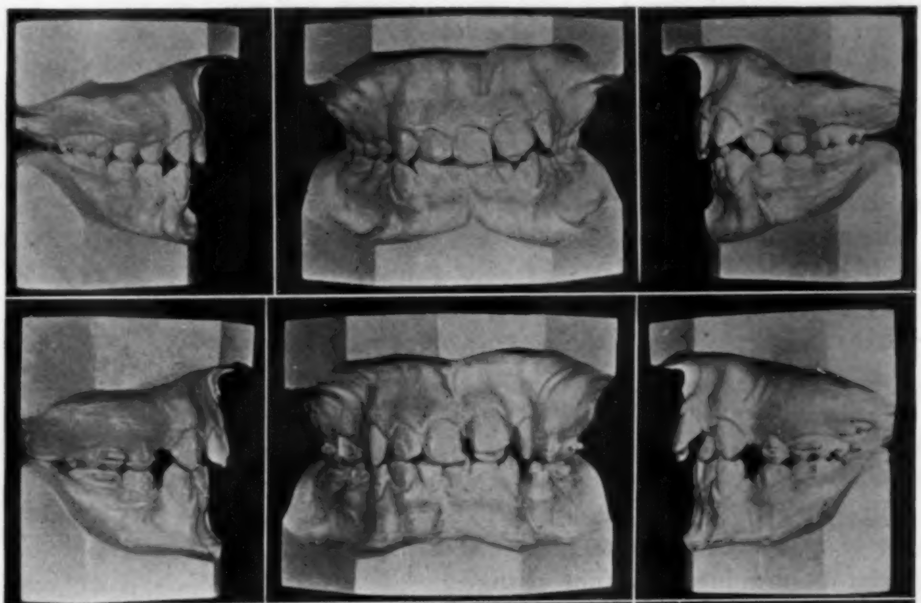


Fig. 8.

well as the maxillary canines were moved distally. The upper left lateral incisor was unlocked and there was increased space for the rotated incisors. Here, also, a mandibular lingual appliance was used for the first three months to allow the cuspids to drift distally because of the extreme crowding of the lower anterior teeth.

Fig. 6 shows the original and progress models after eight months of treatment. The case was undergoing both maxillary and mandibular appliance changes when the progress casts were made.

Molar and premolar relationships seemed essentially the same in both sets of casts. There was satisfactory vertical height when viewed from both front and buccal viewpoints. The maxillary canines were moved distally by the recurved springs from the bite plate before the bands were placed. The bite plate should not have been discarded in this case until the mandibular teeth were all banded.

Fig. 7 shows original and progress models after seven months of wearing a bite plate. The bite was satisfactorily opened and there appeared to be increased vertical height in the posterior teeth.

The maxillary cuspids were moved back to a vertical axial inclination. The left cuspid was moved the greatest amount in an effort to unlock the upper left lateral incisor. The occlusal relationship of molars and premolars appeared to be about the same despite the gradual movement distally of the cuspids.

A mandibular lingual appliance with spurs mesial to the second premolars was used to allow the lower canines to drift distally and upright themselves. Extreme midline discrepancies further complicated the treatment of this case.

Fig. 8 shows the original and progress models of a case eight months after treatment was started. The bite plate was still being worn as the maxillary arch was undergoing appliance change.

This case was complicated due to the congenital absence of the mandibular right central incisor. Upper first premolars only were removed and the canines were moved distally by springs from the bite plate.

Vertical development was quite evident both from the front and side views, and the molar-premolar relationship seemed to have held as the maxillary canines were moved distally.

SUMMARY AND CONCLUSIONS

A.

1. When a bite plate is used as an adjunct to orthodontic treatment, increased vertical dimension is obtained by eruption of the posterior teeth and the growth of the alveolar processes. The appliance may be placed very early in treatment and without the necessity of banding all of the maxillary teeth. When it is necessary to remove premolars, the cuspids can be guided distally more rapidly and physiologically by the recurved springs from the bite plate than with the conventional bands and arch wires.

2. The lack of optimum vertical height can be demonstrated clinically as well as by cephalometrics. Advantage should be taken of the knowledge and possibilities of the physiologic rest position and interocclusal clearance, or freeway space, in the construction of the bite plate. This applies equally in nonextraction and extraction cases.

3. Case analysis and treatment planning should recognize, if present, the existence of a mandibular displacement, either lateral or posterior.

4. The ease with which certain teeth are moved by springs from the bite plate makes the appliance very adaptable, particularly in extraction cases when complicated by a closed bite.

B.

1. All stainless steel wires used in the construction of the appliance are stress relieved for three minutes at 85° F. in a suitable electric furnace equipped with a pyrometer, and then polished before waxing to the model.

2. The flat bite plane is preferable to the inclined plane because of the danger to the mandibular incisors of being tipped forward when occluding with the inclined type. It is also felt that the flat plane allows the mandible to seek its own position rather than to be "jumped forward," the possible exception to this being certain Class II, Division 2 malocclusions in which a distally displaced mandible is present.

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643 Stimson Bldg.

Editorial

The American Journal of Orthodontics

APPEARING in this issue is a digest report of the Publication and Editorial Board of the American Association of Orthodontists for the year 1950.

This report contains information concerning the operations of the JOURNAL which should be of interest to subscribers, future essayists, and authors to appear on future programs of societies for which the JOURNAL is the official organ.

The members of the Editorial staff of the JOURNAL are elected by the American Association of Orthodontists and the seven sectional societies, and in spite of many responsibilities to protect, they are obliged to operate under certain specific instructions and limitations.

In the first place the JOURNAL is the official organ of the American Association of Orthodontists and the seven sectional societies, and the American Board of Orthodontics.

The Editorial staff are obliged to operate under several limited conditions, especially the budget for illustrations. This budget should be sufficient if properly managed and understood. If the budget is exceeded, the extra costs must be paid out of the reserve of the American Association of Orthodontists.

It was very embarrassing two years ago for the Editorial Staff to have to call on the American Association of Orthodontists for $580 for extra costs of illustrations imposed unnecessarily by enthusiastic authors who seemingly little realize just who is to pay the cost of illustrations.

The JOURNAL publishes addresses, proceedings, essays, and other materials of the American Association of Orthodontists, the seven sectional societies, and such theses which the American Board of Orthodontics recommends for publication. These form the backlog of material from which each issue of the JOURNAL is arranged so as to avoid repetition.

The JOURNAL Staff is eager to cooperate to the fullest degree with every essayist appearing on "official" programs, but being physically unable to go *all out* for each and every author, we likewise are obliged to expect that friendly cooperation which will lend to instructive reading, and enshrine within the JOURNAL the foremost progress in the science and practice of orthodontics.

Appearing at the conclusion of the report of the Publication and Editorial Board are five recommendations which were made to the American Association of Orthodontists and which were adopted by that body and are now made official.

The execution of these instructions to the essayist will be performed by the Publication and Editorial Board. In each issue of the JOURNAL there will be published a directive from them, properly instructing authors and essayists in the preparation of their manuscripts.

The Editorial Staff of the JOURNAL and the Publication and Editorial Board are exceedingly anxious to cooperate to the fullest extent in this new plan, and in the spirit of mutual assistance and interest, it is hoped that every member of the American Association of Orthodontists and the Sectional Societies will go all out to lend their support to this worthy cause.

J. D. E.

PRESENTATION OF THE ALBERT H. KETCHAM MEMORIAL AWARD, 1951, BY JOSEPH D. EBY, PRESIDENT OF THE AMERICAN BOARD OF ORTHODONTICS

Mr. President, Members of the American Association of Orthodontists, and Guests:

In a poem by Henry Wadsworth Longfellow, entitled, "A Psalm of Life," appears the following verse:

"Lives of great men all remind us
We can make our lives sublime,
And, departing, leave behind us
Footprints in the sands of time."

In this beautiful thought, the famous poet makes no attempt to define what constitutes greatness or how it may be attained. He refers only to its existence as the result or reward of certain achievements. Regardless of the myriad sources from which it may spring, greatness does not come in any prefabricated form. The blueprint of true greatness must include faith in God, practice of the Golden Rule, placement of service above self, unbiased pursuit of truth, an unselfish trust in fellow men, and an enduring determination to become their benefactor.

Notoriety or near-greatness is not the accomplishment of the whole, but rather where the pattern was either wrong, marred, or left unfinished. Greatness is the acclaimation of the world for a permanent and lasting service which, in any field, contributes to the advancement and welfare of mankind.

Truly one of the greatest investments in the capital stock of life is the desire and intent to help other people. The joy is in the service, the reward is the priceless sense of accomplishment.

I am sure every one of us has been inspired to have seen, known, and mingled with our great orthodontists, as well as to have profited by their individual contributions to an ever-growing and expanding beneficient service. To contemplate the handicaps they overcame and the struggles through which they toiled so generously and unselfishly, little dreaming they were to become great, is but the oft repeated story of man's own survival.

If accomplishment is to strive beyond one's reach, then we can all afford to paraphrase Longfellow's poem to read:

Lives of great orthodontists all remind us
We too can make our lives sublime
And, in living, leave behind us
Footprints in the sands of time.

If we will but *do this* and *live it,* then our great men of orthodontics will not have lived in vain, and the firm foundation they so thoroughly laid will always support the orthodontic super-structure of the future.

Presented at the meeting of the American Association of Orthodontists, Louisville, Ky., April 25, 1951.

Benno Edward Lischer was born June 27, 1876, at Mascoutah, Ill. He was the seventh of a family of nine children, seven boys and two girls. His father's ancestry was German, his mother's French, an endowment by the grace of heredity which was destined to influence the dynamic character of of his personality throughout a long and brilliant career.

Dr. Lischer's father had been a builder, so after graduation from high school he entered an apprenticeship as a carpenter in order to learn the builder's trade. It was during this time that he required the professional services of a local dentist, Dr. Julius Palm, who no doubt easily recognized the young lad's hidden genius. With the aid of the family physician, postmaster, editor of the weekly paper, and others who unanimously confirmed Dr. Palm's argument, young Lischer, thus ear-marked, embarked upon his career.

In the autumn of 1897 he entered the Missouri Dental College, later the Dental Department of Washington University, now the University School of Dentistry, receiving the degree of D.M.D. in April, 1900. What undergraduate orthodontics he learned was taught by lectures to the senior class by Dr. E. A. Matteson of Chicago, who also assigned a patient to each student to adjust appliances and continue treatment. Shortly after graduation Dr. Lischer was appointed instructor in dental anatomy and operative technique, which marked the beginning of an unbroken career in college work, leading successively from instructor to teacher, to professor, to Dean, and on to the heights of Educator.

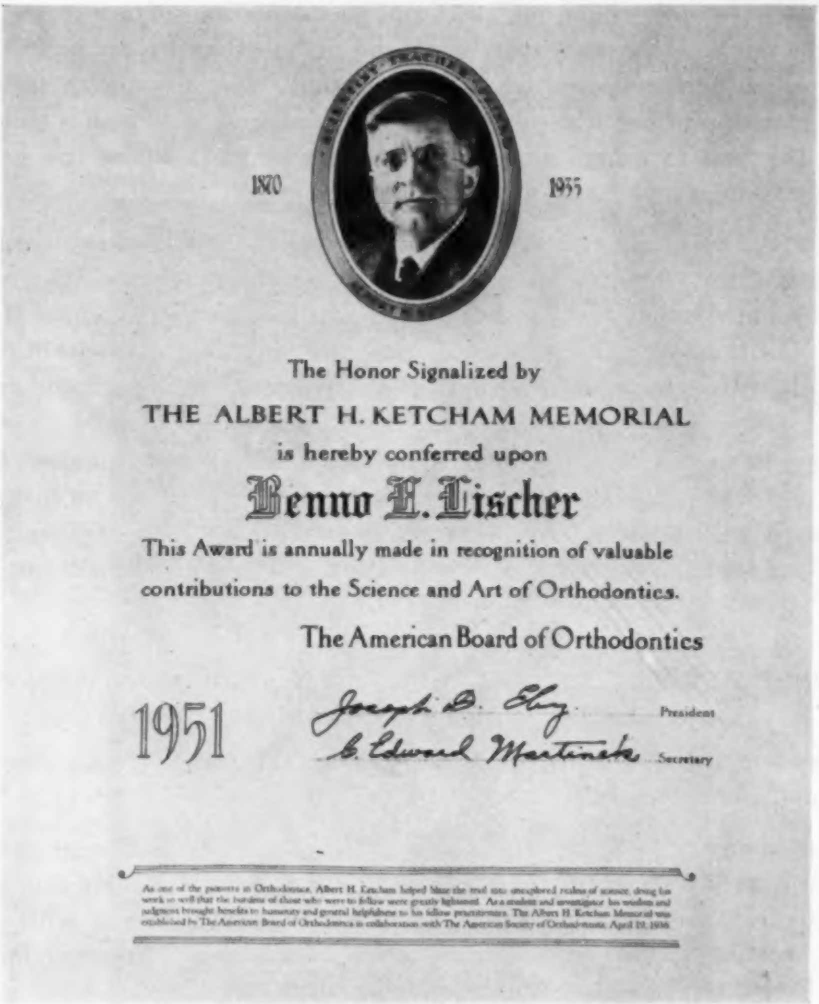
By this appointment, Dr. Lischer fell heir to his classmates' orthodontic patients, who were assigned to him for continued treatment, and thus marked his first opportunity to have a real good look at that branch of dentistry which was the sort of stepchild of the household! Appreciating his lack of knowledge and the difficulties confronting him, the challenge brought forth the determined young dentist who largely had to work out his own salvation, and he did.

Dr. Lischer continued to serve his Alma Mater from 1900 to 1924, becoming Professor of Orthodontics in 1904 and specializing exclusively in its practice in 1906. In 1924 he was appointed Nonresident Lecturer in Orthodontics at the University of Michigan, and continued in that position until 1929. He then accepted an appointment as full-time Professor of Orthodontics at the University of California, devoting his full efforts to undergraduate and graduate education.

Invited by Washington University in February, 1933, to assume the deanship of the dental school, he returned to his Alma Mater as full-time Dean and Professor of Orthodontics, from which position he is now Dean Emeritus.

Among his many original contributions, Dr. Lischer presented the familiar and widely used classification of dentofacial anomalies, i.e., neutroclusion, distoclusion, mesioclusion, with micro and macro deformities. The word "orthodontics" coined by the English etymologist Sir James Murry was championed by Dr. Lischer for adoption in 1910. This met much opposition but through his convincing determination he finally proved the correctness of his claims and the term was almost universally accepted.

Dr. Lischer was President of the American Society of Orthodontists in 1913, Honorary President of the First International Orthodontic Congress in 1926, Chairman of the Orthodontic Section, Seventh International Dental Congress, 1926, President of the American Association of Dental Editors, 1941, and President of the American Association of Dental Schools, 1942-1943.



THE KETCHAM AWARD

Dr. Lischer is the author of "Elements of Orthodontia," 1909, also "Principles and Methods of Orthodontics," 1912. In 1926 he translated Dr. Paul W. Simon's "The Diagnosis of Dental Anomalies" from German into English, which introduced gnathostatics into America. From his prolific pen Dr. Lischer has published sixty-five articles of current literature and practically a similar number of editorials.

In addition to his many contributions and attainments in orthodontics and education his personality has always possessed a firm magnetic attraction.

His staunch courage, strong character, earnestness of purpose, and effervescent manner have always been a guiding influence and an inspiration to his hosts of students, associates, and friends.

> "He has achieved success who has lived well and laughed often; who has gained the respect of intelligent men and the love of little children; who has filled his niche and accomplished his task; who has made the world better than he found it, whether by an improved poppy, a perfect poem, or a rescued soul; who has never lacked appreciation of earth's beauty or failed to express it; who has looked for the best in others and given the best he had; whose life is an inspiration; whose contributions a benefaction."

So now, Dr. Lischer, in recognition of these facts and as evidence of our appreciation, do we herewith in behalf of the membership of the American Association of Orthodontists confer upon you the Albert H. Ketcham Memorial Award. As the eleventh recipient of this, the highest honor within our gift, we hope it will bring as much happiness to you as it does to us in its presentation.

There is an institution in your life which has long been admired by your friends and which you have styled, "My Study Hour." When in future years this Award will recall to you many pleasant memories and recollections and you become lost in a reverie of happy meditation, we hope you will call it "Our Hour!"

RESPONSE BY BENNO E. LISCHER TO THE PRESENTATION OF THE ALBERT H. KETCHAM MEMORIAL AWARD

President Eby, Distinguished Colleagues, Members of the Association, Ladies and Gentlemen:

It is always a pleasure to meet with one's friends in annual convention assembled, to shake their hands of fellowship, and share their fine devotion to the development and progress of orthodontics. Beginning with our first annual meeting in St. Louis (June, 1901), it has been my good fortune to attend for many years, and always with benefit to me.

But to be singled out on this occasion as one who merits your special commendation, as one worthy of a particular award, is an exceptional recognition, one to which I am entirely unaccustomed. Happily, this award is very acceptable to me, for I knew Dr. Ketcham personally for many years, visited his office in Denver, and enjoyed his gracious hospitality as a guest in his home.

It is unnecessary to dwell on Dr. Ketcham's many professional attainments; his contributions to our science and art need no praise from me, for they are known to all students of our literature. Indeed, they have served as guideposts to all who joined our caravan of achievement since his day.

It always seemed to me that Albert Ketcham was motivated by a loyalty to our *possible* achievements, for his was a spirit of high expectation; he had a vision of that far horizon where our fondest hopes dwell; he was devoted to our very highest aim as orthodontists, namely, a desire to know the truth.

Coming from the spacious, western area of our great country, he was imbued with its free and generous spirit—all mankind shall be given the opportunity for an equal share in the happiness of a full life. Thus, he never thought of himself as superior to others, but was one who demanded more of himself. Ably and graciously he lived a full life with talent and personal charm. Accordingly, he added flavor and distinction to his many services.

BENNO E. LISCHER

In contributing my portion to the progress of our specialty as a small part of the share allotted to my generation, I was well rewarded, for in that process I acquired an abiding and deep inner satisfaction—the finest reward it is possible for human beings to earn.

Colleagues of my generation, we can look back with a reasonable feeling of elation to a noble past, considering the difficulties we encountered along the

highway of our progress. And our status today gives promise of a glorious future. Hence, in quiet satisfaction we face days ahead full of ambitious work, of steadfast devotion to the worthy ideals of our predecessors.

Members of the American Board and the American Association of Orthodontists, I thank you heartily for the honor you have conferred on me and I gladly declare, on this happy occasion, that I shall always strive to be worthy of it.

In Memoriam

WILLIAM PLEASANT DELAFIELD
1886 - 1951

WILLIAM DELAFIELD, orthodontist of Dallas, Texas, passed away May 9, 1951, after an illness of about six weeks.

Dr. Delafield was born July 22, 1886, in Mount Pleasant. His father, Dr. William Jackson Delafield, was one of the early dentists of Texas, and a native of Titus County.

After attending the public schools in Mount Pleasant, Dr. Delafield was graduated in 1907 from Vanderbilt University, with a Doctor of Dentistry degree. He entered practice first with his father, then moved to Paris, Texas, just before World War I.

In 1917, Dr. Delafield entered the armed services as a first lieutenant in the Dental Corps. He worked up through the ranks until he was made lieutenant colonel at discharge.

He accepted the chair of periodontia at the Baylor University College of Dentistry in 1921. He held this post fifteen years, while at the same time setting up practice in Dallas, specializing in orthodontics.

He was appointed to the State Board of Dental Examiners and had been president of the East Texas Dental Society and the Dallas Dental Society.

Following his graduation from the International School of Orthodontics in Kansas City, Mo., he became an assistant professor of orthodontics at Baylor.

He was secretary and past president of the Vanderbilt Dental Alumni Association, a member of Hella Shrine, and a member of Psi Phi and Sigma Omicron Kappa dental fraternities. He served as chairman of numerous committees for the state society, and during World War II was chairman of the procurement and assignment committee of the Dallas County Dental Society.

Surviving are his wife, the former Mary Harrel of Nashville, Tenn.; his son, Dr. William Harrel Delafield of Dallas, who was associated with his father in practice; two brothers, Dr. Robert L. Delafield, Austin, and Jones Delafield, Mount Pleasant; a sister, Mrs. Frank Mankins, Mount Pleasant, and two grandchildren.

Reports

DIGEST OF THE REPORT OF THE PUBLICATION AND EDITORIAL BOARD OF THE AMERICAN ASSOCIATION OF ORTHODONTISTS FOR 1950

THE AMERICAN JOURNAL OF ORTHODONTICS, now in its thirty-seventh year, continues to fulfill a function of increasing value in the rapidly expanding progress of orthodontics. This is made possible through the strong support of the American Association of Orthodontists, the seven Sectional Societies, the American Board of Orthodontics, and The C. V. Mosby Company. It should not be forgotten, and full consideration should be given to the fact that the survival of our JOURNAL through many lean years was due to Dr. C. V. Mosby's unflagging determination, and his belief that the growing specialty of orthodontics was destined to achieve a conspicuous place in the field of preventive medicine and in the service of humanity.

During these successive years the frequent annual deficits were absorbed by the Mosby Company. Since Dr. Mosby's death The C. V. Mosby Company has continued the same loyal support, both in deference to Dr. Mosby's wishes and their own desire to cooperate with us.

It is amazing to realize that since 1915 with the completion of Annual Volume 36 as of December, 1950, 432 consecutive monthly issues have been delivered to the profession without a single break—truly a record. These volumes enshrine the priceless record of the progress of orthodontics from its earliest history to the present time.

This is the third annual report since the current contract between the American Association of Orthodontists and The C. V. Mosby Company went into effect as of Jan. 1, 1948.

The three sources of JOURNAL income are advertisements, individual subscriptions, and our A. A. O. bloc. The revenue from advertising is controlled on a rate basis, governed by the number and distribution of subscribers. The advertisers are exclusively those who manufacture orthodontic supplies.

The attraction of the JOURNAL to individual subscribers is limited by the economic factor, i.e., the $10 annual subscription price, as well as by its reader interest, which is dependent upon the practical value of the published articles to non-A. A. O. members. The Editorial Staff diligently strives to maintain the highest scientific and practical level for the members of those supporting organizations for whom the JOURNAL is the official organ and the repository of their literature and records.

In the first annual report after the present contract went into effect on Jan. 1, 1948, this Board made the following recommendations: "If each Sectional Society would agree to contribute $1.00 from its treasury for each active member in that section we would have an increase, with our present total membership of the sum of $903.00 per year for the JOURNAL. This would seem a fair distribution, since the smaller sections would pay a smaller amount, each section in proportion to income from dues."

In the report of this Board for the second calendar year under the present contract there appears the following: "'But difficulties continue to arise when a mass of more or less superfluous material accumulates a needless expense. Neither is it the definite aim of the Editorial Staff to stay within the limits of the Mosby Company's allowance at the expense of the finest preparation and presentation of our literature, or in any way attempt to increase their profits, but economy must be practiced rigidly.''

To this end former President Max E. Ernst has expressed the following opinion: "I would like to reiterate a statement I have made before, namely: that scientific papers presented before Sectional Societies are published for the benefit of the entire membership of the Association, and, if necessary, the JOURNAL deficit should be underwritten by the treasury of the Association rather than by the constitutent societies."

At the 1948 meeting of the A. A. O. when the present contract with the Mosby Company was put into effect it was necessary to make it retroactive as of Jan. 1, 1948. It is recalled how staunchly that Board of Directors stood by the JOURNAL, even to the extent of recommending an increase of the annual dues of the A. A. O. by five dollars per year, two dollars of which was to be used to increase the JOURNAL annual en bloc subscription from $5.00 to $7.00.

This Publication and Editorial Board wishes to emphasize to the Directors of the A. A. O. the fact that in these first three operational years under the present contract the Mosby Company has produced and delivered thirty-six issues of the JOURNAL at a net loss of $990. It is also an equally serious fact that the $150 per month paid under contract by the Mosby Company as a donation to editorial expense is in no way, shape, or form anywhere near adequate.

It is therefore recommended that the American Association of Orthodontists should assume its own responsibility by paying out of income a stipulated monthly amount to the Editor-in-Chief in order that he may employ sufficient secretarial assistance and provide the necessary facilities for the proper edition and management of the heavy correspondence and other affairs of the JOURNAL.

The Editorial Staff maintains a rigid censorship over so-called ''original articles." Many essayists accept invitations to appear with "key" papers with the understanding, for good reasons, that they will not be published. Others, talking freely from slides or notes, are recorded but the transcriptions are never edited out. Others either use color slides or such a profusion of illustrations that they are never digested and properly prepared for publication. A recent trend, which is a problem to the JOURNAL, lies in the fact that essayists accumulate libraries of Kodachrome transparencies from which they make priceless scientific and clinical presentations of fundamental progress without ever the slightest intention of preparing the material for publication. These potential contributions, which come up with increasing frequency, are lost both to the JOURNAL, and even more deplorable, are lost to the records of our modern literature and progress. It is obvious that this is not a healthy situation at present nor for future prospects. As a serious dilemma something must be done about it, and in a systematic manner it must be called to the attention of the officials of the Sectional Societies so that future essayists and authors may be properly instructed.

It is obvious that the JOURNAL can publish more literature and needs a deeper backlog from which to select the best possible distribution of subject matter per issue. It is also quite apparent that the present liberal display of illustrations should be fully adequate for more articles, if properly distributed. For instance, the JOURNAL carried one article this past year containing 37 illustrations covering 447 square inches, an equivalent of ten full pages, cost paid by author. It is therefore urgently requested that the Board of Directors of the A. A. O. should initiate official action concerning this drifting but correctable condition.

It is therefore recommended that the A. A. O. issue official instructions to all Presidents, Executive and Program Committees in order that essayists and authors, as far as practical, shall prepare their manuscripts and illustrations as uniformly as possible for publication. It is recommended that such instructions should direct that a written manuscript be accompanied by the minimal number of illustrations sufficient to portray the substance of the text to the reader. Attention may then be called to the fact that an essayist could ad lib all he wanted with illustrations upon presentation, without throwing a superfluous and expensive load of illustrations into the literature, which most readers would pass over anyway.

In conclusion, the Publication and Editorial Board respectfully submits for your serious and constructive consideration the following recommendations:

1. That, under proper control, it is feasible to stay within the present $2,000 budget for illustrations, without jeopardizing the best interests of our literature and authors, or imposing an unknown additional expense on the A. A. O.

2. That many valuable articles are lost for publication because they were not prepared for such.

3. Authors expecting to have published, without expense, a profusion of illustrations impose a difficult task upon the editorial staff.

4. That the JOURNAL could be increased in value by more articles but not by more illustrations.

5. That the A. A. O. should adopt official instructions for essayists, including all constituent societies, as to the manner in which their manuscripts should be prepared for publication first and for presentation second.

Respectfully submitted:

SILAS J. KLOEHN
EARL E. SHEPARD
JOSEPH D. EBY, Chairman

GEORGE R. MOORE, Secretary-Treasurer, A. A. O.

REPORT OF THE RESEARCH COMMITTEE, AMERICAN ASSOCIATION OF ORTHODONTISTS, 1951

THE Research Committee respectfully submits to the Board of Governors of the American Association of Orthodontists its annual report as follows:

In the year which has passed since the publication of the last annual report of this committee, two main areas of activity have been the concern of the Research Committee: the annual Prize Essay Competition, and the arrangements for the Research Section for the annual meeting, to be held this year in Louisville. In 1951 the Essay Competition observed its sixth year, while the Research Section marked its fourth.

Announcements of the Prize Essay Competition were carried by the *Angle Orthodontist, The Journal of the American Dental Association,* and the AMERICAN JOURNAL OF ORTHODONTICS, through the cooperation of the respective editors. Entries were not submitted in large numbers, but the papers which came in were of high quality and showed evidence of careful, well-disciplined work.

The papers were submitted in triplicate at the Chairman's office in San Francisco and carried no identification. A sealed envelope accompanied each entry, with only the title of the manuscript on the outside. This envelope, which contained the name and address of the author, was removed and filed before the essays were sent to the other members of the committee for judging. Verdicts were sent back to the chairman who then opened the identification envelopes. The results of the judging were as follows:

Winner: Dr. David Watt, University of Otago, New Zealand, for his essay, "The Effects of the Physical Consistency of Food on the Growth and Development of the Mandible and Maxilla of the Rat."

Dr. Watt was notified that he was the winner of the $500 prize and was invited to attend this meeting and to present his paper. As stipulated in the announcement of the contest, the winner receives the above cash prize, and is expected to bear his own expenses in connection with attending the meeting. As was further stipulated, publication rights of papers receiving first prize or honorable mention reside with the American Association of Orthodontists.

Once again Dr. Salzmann carried the entire responsibility for arranging the Research Section for the annual meeting. The official program shows that he has secured a well-rounded list of research papers, coming from several different institutions, and in the view of the Chairman, Dr. Salzmann is to be complimented for his efforts. In all, thirty-one papers were submitted, some to be read by title only.

The Committee has no specific recommendations to make this year to the Board of Governors, beyond extending their thanks to the Board for the cooperation and support which they have given us, and expressing the belief

Presented at the meeting of the American Association of Orthodontists, Louisville, Ky., April 23-26, 1951.

that the Prize Essay Competition and the Research Section be continued in the future. Since, however, this report will presumably be published and thus go to the readership of our official JOURNAL, we entreat all orthodontists and others engaged in research related to orthodontics to keep in mind throughout the entire year the availability of the Research Section of our annual meeting as a forum for the exchange of new information.

Respectfully submitted,

WENDELL L. WYLIE, Chairman,
ROBERT E. MOYERS,
J. A. SALZMANN.

Department of Orthodontic Abstracts and Reviews

Edited by
DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Reunion Meeting, Department of Orthodontia, University of Illinois, 1948: Published by the Angle Orthodontist by permission of The Edward H. Angle Society of Orthodontists.

This volume contains the collected papers presented at the Reunion Meeting of Alumni of the Graduate Department of Orthodontia, University of Illinois at Chicago, published in the *Angle Orthodontist* in March and April of 1948.

The orthodontic research conducted at the University of Illinois, under Dr. Allan G. Brodie, surpasses anything ever undertaken elsewhere from the standpoint of quantity. Many of the outstanding contributions which have come out of this institution under the inspiring leadership of Dr. Brodie are today accepted as basic in orthodontic science. To the credit of Brodie and his co-workers, it can be pointed out that they have never emphasized system of treatment over etiology and diagnosis.

A review of the research activities at the University of Illinois is presented by Dr. Brodie. Among other things, he points out the hardships under which the Department of Orthodontia operated during its earlier years and the number of graduates who are now teaching orthodontics at various universities throughout the country. We found Brodie's review of eighteen years of research at Illinois to present a summary which encompasses not only the contributions of Illinois, but also the work of others during the past twenty years or more. This is an authoritative source work on orthodontic research.

Included among the papers published in the book is "Guiding Alveolar Growth and Eruption of Teeth to Reduce Treatment Time and Produce a More Balanced Denture and Face," by S. J. Kloehn, in which is described the technique of the "E" arch and headcap for treatment in the mixed dentition period. Alveolar growth and eruption of teeth when guided by orthodontic means at an early age can frequently be productive of better facial balance, and the severity of malocclusion can be reduced so that treatment during the permanent dentition period is also reduced. The need for extraction, Kloehn points out, may frequently be reduced by early treatment.

A valuable technical procedure is presented by Earl W. Renfroe on the making of plastic retainers without flasking or packing. The retainer is made from a sheet of polystyrene.

An interesting appraisal of the treatment of Class III malocclusions is presented by Dr. A. Goldstein in which it is shown that combined orthodontic and surgical management is frequently the most adequate method of treating Class III malocclusions in adults.

A study of the facial patterns associated with Class I, Class II, Division 1, and Class II, Division 2 malocclusions is presented by Renfroe. In conjunction with the findings of Adams, Elman, and Baldridge, whose papers are included in the book, Renfroe presents conclusions to the effect that Class II malocclusions

are not characterized by lack of mandibular development. Furthermore, the maxillary first permanent molar, instead of being anterior to its normal position, actually has a tendency to lie posteriorly. The mandible is the prevailing characteristic of Class II, lying in a posterior position as claimed by Angle. Class III relationships are considered by Schoenwetter and Stapf.

Cephalometric appraisal of treated hypothyroid children by Gold, Engle, and Bronstein is included. An appraisal of extraction and treatment of malocclusion by Cole emphasizes the fact that closure of the extraction spaces is accomplished by anterior movement of the molars and posterior movement of the incisors. Litowitz writes on the movement of certain teeth during and following orthodontic treatment.

"Variations in Facial Relation" by William B. Downs, the first prize winning paper in the essay contest of the American Association of Orthodontists, is included. Downs's work is now generally accepted in orthodontics. It was in this paper that Downs pointed out that the individuals possessing excellent occlusions tend to follow a representative mean or average facial pattern.

The rest position of the mandible and its application to analysis and correction of malocclusion by John R. Thompson is presented in full in this book. The data presented in this paper have since been widely accepted not only in orthodontics but in the field of prosthesis.

Facial clefts and their surgical management in view of recent research by Slaughter and Brodie calls attention to the fact that surgery can and does inhibit normal growth in cleft patients. Growth interference is directly proportional to the amount of injury to the growth centers and to the blood supply. Additional evidence is presented to show that congenitally deformed parts, unless otherwise interfered with, continue to grow at normal rates. It is indicated that poor surgery or poorly timed surgery can do more damage than good in the long run.

Wylie, in his discussion of anteroposterior dysplasia, presents a method whereby discrepancies in size of facial bones occurring in the anteroposterior plane of space may be assessed quantitatively. Wylie's method permits the localization of anteroposterior dysplasia in one or more of five different areas, the measurement of the amount of the dysplasia, and indicates also the need of looking elsewhere for existing dysplasia.

This book can be highly recommended as a reference, text, and source work on modern orthodontics.

J. A. S.

Body Size Norms for Children Four to Eight Years of Age: By Howard V. Meredith, Ph.D., Eugene, Ore. *J. Pediat.* **37**: 183-189, August, 1950.

This article presents some research results on the body size of well-nurtured, nonpathologic, white children assembled in convenient form for use by pediatricians and school physicians.

Whenever norms are presented for practical use, the practitioner needs to know how they were obtained. The intelligent use of any biologic "frame of reference" presupposes a sound functional knowledge regarding the subjects and methods employed in its derivation.

The subjects from whom the norms of this paper were obtained were children 4 to 8 years of age enrolled between 1940 and 1949 in the University of Iowa experimental preschool laboratory and elementary school. All were physically normal boys and girls of northwest European ancestry and of the professional or managerial socioeconomic groups. The environmental condi-

tions with reference to nutrition and health care were generally superior; in almost all instances the children had been under continuous pediatric guidance from birth.

All of the anthropometric examinations were made within one week of each child's birthday. Consequently, the norms for "4 years" are based exclusively on children measured at or very near this postnatal age, the norms for "5 years" on children at or very near this postnatal age, and so forth.

The nine measures are defined below in a manner as succinct as appears compatible with their clear characterization.

Chest Girth.—The instrument used in taking all of the girth measurements was a steel millimeter tape. Chest girth was determined as the circumference of the trunk at the level of the xiphisternal junction. In preparation for measurement each child stood in a natural manner with head erect and with the upper extremities relaxed and held slightly away from the sides of the body. The tape was passed around the thorax in a horizontal plane at the xiphisternal level and brought into light contact with the skin. The reading made was the median girth during normal respiration.

Abdomen Girth.—Wherever possible, this was determined as the circumference of the trunk at the level of the umbilicus. In children showing umbilical protrusion, the tape rested against the perimeter of the abdomen at a level immediately above the umbilicus. The posture of the child, the tension applied to the tape, and the attempt to obtain a midrespiration record were all the same as for chest girth.

Arm Girth.—The measurements of arm girth, length of upper limb, and leg girth were taken on the left side. For measurement of arm girth the child stood in a natural manner with the upper extremities hanging in a relaxed condition at the sides of the body and with the left extremity slightly abducted so that the arm was not in contact with the lateral wall of the thorax. The tape was passed around the arm approximately halfway between the shoulder and the elbow. This area was explored to find the greatest girth at right angles to the long axis of the limb and inferior to any surface indication of the deltoid muscle. The reading was taken with the tape in sufficiently light contact with the skin to avoid compression of the tissues.

Leg Girth.—The child stood with his feet about 6 inches apart and his weight distributed equally through both lower limbs. Maximum circumference of the left leg was determined by passing the tape around the leg in the region of the calf and exploring to find the largest reading at right angles to its long axis. As for arm girth, the tape was read at "light contact" tension.

Shoulder Width.—Sliding metal calipers having broad flat aluminum branches were used in taking this and the succeeding measurement. The shoulder breadth obtained was biacromial diameter. Each child stood with upper extremities extended downward and the shoulders neither "slumped forward" nor "thrown back." Moderate pressure was applied to the caliper branches in order to have the record approximate the skeletal distance between the most lateral points of the acromion processes.

Hip Width.—This measurement was determined as the distance between the lateralmost point of the crest of the right ilium and the corresponding landmark for the left ilium, i.e., as bi-iliocristal diameter. After each branch of the calipers had been brought squarely in contact with one of the landmarks, heavy pressure was used in order to approach maximum compression of the overlying soft tissues. In the event the child turned his hips as the pressure was applied, the measurement was retaken.

Stem Length.—The child sat erect on a horizontal bench with his ankles crossed and his knees spread apart. His lower and upper back made contact with an upright board to which a millimeter scale was attached. Stem length was determined as the distance from the surface of the bench to the vertex (the highest point of the head when the head is oriented with the tragion-orbitale plane at right angles to the long axis of the trunk). It follows that stem length is synonymous with vertex-rump length or erect sitting height.

Upper Limb Length.—This measurement was made with wooden sliding calipers and, as previously mentioned, was taken on the left extremity. After extending the extremity at the side of the body and rotating the hand so that its palmar surface faced the lateral surface of the thigh, the distance was found from the most lateral point of the acromion process to the most distal point of the middle finger. The instrument was applied from the rear, care being taken to keep its shaft parallel with the long axis of the limb and to guard against the tendency of many children to tilt the shoulder axis as the limb is extedned.

Lower Limb Length.—This measurement was derived by subtraction of each child's stem length from his stature. Stature was measured erect as the distance from soles to vertex with the child oriented against the same anthropometric board used in taking stem length. The child stood with feet almost together; plantar surfaces of heels in firm contact with the floor; and heels, buttocks, upper part of back, and rear of head in contact with the board.

All of the measurements were taken on the nude body and obtained with exceptional care. For every child, two anthropometrists each secured a separate series of records. In instances where their results failed to show close agreement, additional measurements were made. Such research rigor affords the clinician ample assurance that the norms were developed with highly reliable data.

How were these norms constructed? In other words, what procedures were followed in establishing the five normative categories: small, moderately small, average, moderately large, and large?

First, the data were separated according to age, sex, and body dimension, i.e., the 105 measurements of chest girth on 4-year-old boys were placed in one group, the 105 measurements of abdomen girth on 4-year-old boys in a second group, and so forth. Next, each group of measurements was arranged in order (from the lowest value to the highest) and the tenth, thirtieth, seventieth, and ninetieth percentiles determined. Finally, in a manner analogous to that in which four embryonic slits establish five digits on each hand and foot, these four percentiles were used to delimit the five body size categories.

The thirtieth and seventieth percentiles were used as the limiting values for the normative category designated "average," the tenth percentile as the lower limit of the "moderately small" category, and the ninetieth percentile as the upper limit of the "moderately large" category. This means that the lowest 10 per cent of each series of measurement values (e.g., the series of chest girth values on the 105 4-year-old boys) define the "small" category, the next 20 per cent the "moderately small" category, the middle 40 per cent the "average" category, the next 20 per cent the "moderately large" category, and the highest 10 per cent the "large" category.

The foregoing description of the source and nature of the norms—of how, when, and on whom the basic data were collected and by what statistical procedures the normative categories were delimited—has laid the necessary foundation for a sound working understanding of their use and interpretation. This working understanding possibly can be made more concrete through a few illustrations.

1. Child N., a boy 5 years of age, is measured in accordance with the methods described in this paper and found to have the following body dimensions: chest girth, 60.3 cm., arm girth, 21.8 cm., shoulder width, 27.5 cm., stem length, 67.4 cm., and lower limb length, 53.9 cm. Reference shows this child to fall consistently in the "large" category, i.e., in each aspect of body size measured he ranks among the largest 10 per cent of well-cared-for United States white boys of northwest European ancestry.

2. Body dimensions for Child O., a girl 6 years of age, are: chest girth, 54.6 cm., leg girth, 24.0 cm., hip width, 18.7 cm., stem length, 59.8 cm., and lower limb length, 47.2 cm. Reference shows the chest girth, leg girth, and hip width values to be "average" and the stem length and lower limb length values to be "small." It follows that in terms of the norms this child is short in stature and of stocky build.

3. Child R., a girl 7 years of age, is found to measure 17.0 cm. in arm girth, 23.4 cm. in leg girth, 53.9 cm. in upper limb length, and 58.8 cm. in lower limb length. This girl has "moderately large" limb lengths and "moderately small" limb girths. Specifically, while over 70 per cent of well-cared-for white girls have shorter limbs, less than 30 per cent have limbs of smaller girth. What are the implications? This is a child who warrants careful study to determine whether the norms are registering a healthy slenderness of build or an undesirable state of health arising from some disease condition, nutritional need, or activity deficiency.

4. Measurements for Child M., a boy 8 years of age, are: chest girth, 60.5 cm., abdomen girth, 67.0 cm., stem length, 70.4 cm., upper limb length, 51.8 cm., and lower limb length, 55.2 cm. Accordingly, the child is "average" in chest girth and stem length, "large" in abdomen girth, and "small" in length of the upper and lower limbs. The shortness of limbs in relation to stem, and predominance of abdomen over thorax, may merit thorough pediatric appraisal with reference to the advisability of attempting acceleration of development through a glandular or alternative treatment program.

5. This last example is taken to indicate the usefulness of the norms in progress evaluation. Assume that Child S., a boy, has been examined at 4, 5, and 6 years of age and found to be "average" at each of these ages in all four girths. At 6 years of age his specific records were chest girth, 56.0 cm., abdomen girth, 54.9 cm., arm girth, 17.8 cm., and leg girth, 23.7 cm. Now, at the age of 7 years, his girths are found to be 61.2 cm. for chest, 62.5 for abdomen, 20.9 cm. for arm, and 27.8 cm. for leg, so that in each instance he has shifted into the "moderately large" category. Having brought these growth facts to the attention of the medical clinician, the norms have discharged their function. It is for the school physician or pediatrician to determine what the facts imply, e.g., to discover whether they reflect a healthy trend toward greater stockiness of build or, perchance, a drift toward obesity which may be counteracted in its early stages by competent psychologic and dietary guidance.

SUMMARY

Norms are presented for nine measurements of external body size. They cover the age period from 4 to 8 years for each sex. Description is given of the subjects, the anthropometric procedures, and the method of norm construction. Illustrations indicate different uses of the norms.

News and Notes

American Association of Orthodontists

Upon the recommendation of the Convention and Planning Committee of the American Association of Orthodontists,

St. Louis, Mo.	1952
Dallas, Texas	1953
Detroit, Mich.	1954

were officially selected as the next three meeting places of the American Association of Orthodontists.

Past Presidents of the American Association of Orthodontists

The illustration shows Past Presidents of the American Association of Orthodontists who attended the luncheon at the Fiftieth Anniversary Meeting, held in April, 1951, at Louisville, Ky.

Top row (left to right), Charles R. Baker, Evanston, Ill., William E. Flesher, Oklahoma City, Okla., Leuman M. Waugh, New York, N. Y., H. C. Pollock, St. Louis, Mo., William A. Murray, Evanston, Ill., Claude R. Wood, Knoxville, Tenn., James Burrill, Chicago, Ill., Earl G. Jones, Columbus, Ohio., Lowrie J. Porter, New York, N. Y., Max E. Ernst, St. Paul, Minn., Joseph E. Johnson, Louisville, Ky.

Bottom row (left to right), Lloyd Lourie, Florida; Alfred P. Rogers, Boston, Mass., Benno E. Lischer, St. Louis, Mo., Oliver W. White, Detroit, Mich., Ralph Waldron, Newark, N. J., Joseph D. Eby, New York, N. Y., Walter Ellis, Buffalo, N. Y., Oren A. Oliver, Nashville, Tenn.

Northeastern Society of Orthodontists

The next meeting of the Northeastern Society of Orthodontists will be held at the Hotel Warwick, Philadelphia, Pa., on Nov. 12 and 13, 1951.

Great Lakes Society of Orthodontists

The Twenty-second Annual Meeting of the Great Lakes Society of Orthodontists will be held Nov. 5, 6, and 7, 1951, at the Statler Hotel, Cleveland, Ohio.

Tufts Graduate Orthodontic Study Club

The Tufts Graduate Orthodontic Study Club held its Second Annual Meeting at the Harvard Club, Boston, Mass., on May 5 and 6, 1951.

The program consisted of case reports by:

Lawrence G. Alexander
Jacob H. Belofsky
Norman M. Cetlin
Henry Kaplan
Irving Kraut
Wallace S. Morlock
Thad. R. Morrison, Jr.
Everett Shapiro

of reports of the Tweed Seminar by:

Herbert I. Margolis
Pierre J. Garneau
Arthur V. Greenstein
George Gales

and lectures and demonstration of the Bull Technique in the treatment of orthodontic patients by:

Harry L. Bull
Brainerd F. Swain

Denver Summer Seminar

The fourteenth Denver Summer Seminar for advanced study of orthodontics will be held at the Park Lane Hotel in Denver, Colo., Aug. 5-10, 1951. The Denver Summer Seminar was organized in 1936 by students and friends of Dr. Albert H. Ketcham, and is dedicated to his memory. The program will be contributed by Drs. Krogman, Glupker, Salzmann, and Chipman. The officers and executive council of the Denver Seminar consist of the following members:

Martin J. Mayeau, Chairman, Wheaton, Ill.
William M. Pugh, Wichita, Kan.
Harry R. Faulkner, San Diego, Calif.
Wm. Weichselbaum, Jr., Savannah, Ga.
Jack E. O'Donnell, Wichita, Kan.
Elmer S. Linderholm, Secretary, Denver, Colo.

The New Orleans Dental Conference

The Fourth Annual New Orleans Dental Conference will be held at the Roosevelt Hotel, New Orleans, Nov. 11, 12, 13, and 14, 1951.

Dr. M. R. Matta, Secretary,
629 Maison Blanche Bldg.,
New Orleans, La.

European Orthodontic Society

The European Orthodontic Society held its Twenty-seventh Biannual Congress at Lillehammer, Norway, from May 31 to June 5, 1951.

The program follows:

Opening of the Congress.
President's Address.

Papers:

Professor Gösta Glimstedt, M.D., Sweden. Embryology and Orthodontics.

James Scott, M.D., Belfast. The Comparative Anatomy of Jaw Growth and Tooth Eruption.

Johan Torgersen, M.D., Norway. Genetics and Morphologic Significance of Cranial Sutures.

Mr. Egril Harvold, Norway. Asymmetries of the Upper Facial Skeleton and Their Morphologic Significance.

Miss Lilah Clinch. A Report on Models of 158 Australian Aborigines.

Dr. Jean Cauhépé, Paris. Heredity and Growth. (The paper was read by Dr. Gugny.)

Prof. E. Muzj and Prof. G. Maj Roma. Significant and Conclusive Data on Correlations Between Organs of the Cranial and Facial Skeleton and Different Types of Facial Profile.

Dr. Lucien de Costar, Belgium. Heredity Potentiality Versus Ambient Factors, Studied by a New Line of Reference on Superimposed Teleradiographs.

Arne Björk, Dr. Odont., Sweden. A Discussion of the Significance of Growth Changes in Facial Pattern and Their Relationship to Changes in Occlusion.

Mr. Kaare Reitan, M.S.D., Norway. The Tissue Reaction as Related to the Functional Factor.

Film Demonstrations:

Prof. Edmundo Muzj, Rome. The Mechanism of Formation of Primary and Secondary Dental, Maxillary, and Facial Deviations During Development.

Mr. Clifford F. Ballard, F.D.S.R.C.S., London. Facial Musculature and Dental Anomalies. (With Commentary.)

Dr. Rodney Dockrell, Dublin. Classifying the Aetiology of Malocclusions.

Prof. K. G. Bijlstra, Holland. A Preliminary Report of a Case of Identical Twins.

Dr. José Clavero Juste, Spain. Collaboration on the Problem of the Maxillary Expansion.

Prof. Anders Lundström, Dr. Odont., Sweden. The Aetiology of the Crowding of the Teeth and Its Bearing on the Treatment. (Expansion or Extraction.)

Mr. Erik Stein Telle, Norway. A Study on the Frequency of Malocclusion.

Mr. Hamish A. Anderson, Glasgow. Growth and Development of the Jaws From the Age of Three Months to Fifteen Years Revealed by Cephalometric Radiographs.

Prof. E. Muzj, Rome. Motion-picture Demonstration of the Play of Inclined Planes in the Functional Orthopedic Therapy.

Each of the following Demonstrators gave a short review of his ideas prior to the group-demonstrations.

Dr. Birger Kjellgren, The Eastman Institute, Stockholm. Bite and Face Restoration in Cases of Cleft Palate.

Mr. Arne Bøhn, Oslo. Retention Constructions, Following Mr. Harvold's Method of Repositioning of the Maxillary Complex in Cleft Palate Cases.

Mr. Olaf Engh, Oslo. Various Types of Removable Plates Used in Public Dental Health Service.

Mr. Harold G. Watkin, Liverpool. Resection of the Mandible to Correct a Case of Inferior Retrusion.

Mr. K. E. Pringle, London. The Use of Film Strip for the Presentation of Serial Orthodontic Material.

Mr. S. E. Wallis and Mr. Glass, London. Some Simple Orthodontic Cases, Treated Under the National Health Service.

Mr. G. FritzGerald, Dublin.

Mr. H. Lester Leech, London. Appliances for the Treatment of Collapsed Lower Arch.

Mr. M. A. Kettle, London. Fixed Appliances in Stainless Steel.

Iowa Orthodontic Study Club

The Annual Meeting of the Iowa Orthodontic Study Club was held June 11, 1951, at the State University of Iowa at Iowa City. Guest essayist was Dr. Ben L. Herzberg, Chicago,

Ill., who presented his conception of diagnosis following the Tweed philosophy. The essayist presented a large table clinic, following his talk, augmenting those given by a number of the members of the club.

The newly elected officers for the season 1951-1952 are as follows:

President, Dr. James E. Berney, of Davenport, Iowa.
Secretary-Treasurer, Dr. Kennith J. Alley, of Des Moines, Iowa.

General Armstrong Appointed New Army Surgeon General

The Senate has confirmed the Presidential nomination of Major General George E. Armstrong to be Surgeon General of the Army for a statutory four-year term beginning June 1, 1951.

General Armstrong succeeds Major General R. W. Bliss, under whom he has served as Deputy Surgeon General for the past four years.

General Armstrong was born on August 4, 1900, near Springville, Lawrence County, Ind. He received an A.B. degree in 1922 and an M.D. degree in 1925 from the University of Indiana. After serving in the SATC in 1918, he enlisted as a private in the National Guard of Indiana in March, 1923, and was honorably discharged as a Technical Sergeant in 1925 to accept a commission as a First Lieutenant in the Army Reserve Corps. Following internship at Letterman General Hospital, San Francisco, Calif., he was commissioned a First Lieutenant in the Regular Army Medical Corps on July 9, 1926.

His first tour of duty was attendance at the Medical Field Service School, Carlisle Barracks, Pa., from which he was graduated with honors. Subsequent schools included graduation from the Army Medical School, Washington, D. C., with honors; Advanced Course, Medical Field Service School and the Command and General Staff School, Fort Leavenworth, Kan.

He has served at various posts since his entry on active duty, including Walter Reed General Hospital, Washington, D. C., Fort Benning, Ga., Tientsin, China, and Fort Stotsenberg, Philippine Islands.

During World War II, he served as Assistant Theater Surgeon, China-Burma-India, 1943-1944, followed by two years as Surgeon of the Chinese Theater. He returned to the United States in July, 1946, after three years of overseas service, to serve as Chief of Personnel, Surgeon General's Office, Washington, D. C. In June, 1947, he was appointed Deputy Surgeon General.

He is a Fellow of the American College of Surgeons and the American Medical Association; a member of the Association of Military Surgeons of the United States Masonic Blue Lodge; Scottish Rite and Shrines; Phi Kappa Psi; Alpha Omega Alpha; Phi Rho Sigma; and Scabbard and Blade Fraternities. He serves as a member of the House of Delegates of the American Medical Association; liaison member of the Executive Council of the Association of American Medical Colleges; and is a member of the Board of Directors of the American Bureau for Medical Aid to China.

His decorations include the Legion of Merit, the Army Commendation Ribbon, World War I Victory Medal, The American Defense Service Medal, the Asiatic-Pacific Campaign Medal with three bronze stars, World War II Victory Ribbon, Chinese Cloud and Banner, Chinese Legion of Honor, and the Order of the Crown of Italy (Commandership).

General Armstrong resides with his wife and son, George B., in Arlington, Va. His son was recently selected for appointment to the United States Military Academy at West Point, N. Y.

General Bliss Reports on Medical Program

In comparison with World Wars I and II, the medical record in Korea is remarkable, Major General Raymond W. Bliss, Surgeon General, United States Army, declared after a thirty-day tour of medical installations in Japan and Korea.

"Approximately 98 per cent of all wounded or ill soldiers who come to Army hospitals live, in comparison to World War I's rate of 92 per cent and World War II's rate of 95.5 per cent," General Bliss said.

"This enviable record has been accomplished through the able administrative and technical direction of the officers in charge of the medical program in the FEC, from the highest to the lowest rank. It shows great forethought, energy and selfless devotion to duty and to the medical profession.

"Our troops are fighting in a country which is disease ridden and where epidemics are common. Yet the sick rate of our troops in Korea is as low as with the troops in the United States. We have not had a single epidemic among the troops since they went into Korea."

Most of the illnesses present in Korea are common colds and respiratory ailments, according to General Bliss. The remarkable record of low disease rate is accounted for by three main factors. He said the first is education—the soldier is taught self-care in the prevention of disease. Second is the immunization factor, accomplished by vaccinations which have been practically 100 per cent effective. Third is the sanitation factor, such as purification of water, care of food, and cleanliness.

Medical teams work as close to the front as possible so that the wounded get immediate care, General Bliss said. Close behind the lines are the Mobile Army Surgical Hospitals, which are so set up as to enable them to move in a matter of hours.

"The rapidity with which they move, the efficiency with which they operate amazed me," General Bliss said. "I saw the 8055th MASH unit arrive near Seoul and begin work almost immediately. This was the 25th move for this unit since its arrival in Korea. The day I was in Wonju, half of the 8076th MASH unit had moved forward and was operating independently, while the other half remained behind, also operating as an independent unit. This unit had moved 15 times since its arrival in Korea."

General Bliss said the use of helicopters by these MASH units has been most successful. Each MASH has a number of helicopters attached to its unit. The pilots live with the units and their helicopters are in the "back yard" of the hospitals. When a call comes in from a clearing station at the front lines, the helicopter takes off and returns shortly with the patients. The helicopters now in use in Korea carry two patients, strapped in basket-type litters on the outside of the helicopter. General Bliss said a new type is being tried out in Korea. It is a Sikorsky helicopter that can carry eight litter patients inside the plane. There is only one of these now in operation in Korea.

"We are constantly planning and doing research on preventive and curative medicine," General Bliss said. "The finest medical men in America have been sent to the FEC to teach and to learn. We have a continual chain of information going to research institutes in America and we are utilizing the doctors who have returned from Korea at our institutions in America to train officers and enlisted men.

"In my position in the Army," General Bliss concluded, "I view this great medical achievement with the deepest humility. I offer my sincerest congratulations to the doctors, nurses, Women's Medical Specialist Corps, medical enlisted men and WAC medical technicians, who have made this record possible. In particular, I cannot pay enough tribute to the work of the nurses in Korea. The marvelous job they are doing under the most trying conditions and hardships, exemplifies, to me, the great and admirable spirit of the American women."

General Bliss, who was accompanied on the tour by Major General Edgar Erskine Hume, Surgeon, FEC, left for Washington Sunday.

(Reproduced by the Technical Information Office, Office of the Surgeon General, Department of the Army.)

American Dental Association

A recommendation that special treatment, both psychological and dental, be given to the child who sucks his thumb beyond the age of three and one-half was made today in *The Journal of the American Dental Association.*

"It is a habit which produces a penalty of subsequent deformity out of all proportion to the crime," Dr. Edward S. Mack, of San Francisco, instructor in dentistry for children at the School of Dentistry, College of Physicians and Surgeons, declared.

"A feeling that he is loved and is secure should be instilled in the young child," he said.

Dr. Mack, however, took issue with the point of view that prevention of thumb-sucking can cause a deep-seated frustration. Pointing out that there are many natural behavior patterns which must be curbed or stopped in the child, he named lying, stealing, showing hate openly for persons, having temper tantrums, or putting all available objects in the mouth.

"Each of the training processes involving these acts . . . are to a great degree frustrations," Dr. Mack said. "Since it is natural for an infant to put most available matter into his mouth, the stopping of this act is a frustration of a natural behavior pattern.

"Compared to the intensity of frustration involved in the afore-mentioned necessary frustrations, the correction of thumb-sucking hardly bears mentioning. It is by no means capable of disturbing the psychic balance to as great an extent as some of these. Yet, this habit is not tampered with because of fear of frustration alone."

Dr. Mack listed possible effects of thumb-sucking as abnormal development of the jaws, misshapen nose and lip structure, irregular permanent teeth, speech defects, and mouth breathing that may lead to respiratory infections.

He suggested as the most effective way of breaking the habit a device temporarily cemented to the teeth called a "hay rake."

"It presents a series of tines which act as a fence to prevent thumb-sucking and tongue-thrusting," he explained. "The ends of the tines constantly remind the tongue to keep behind the appliance. Used properly it . . . is always successful."

He said such practices as ill-tasting medicines on the thumb, finger guards, gloves, closed sleeves, and the like were often ineffectual in breaking the habit.

Dr. Mack quoted one pediatrician who contended there was no more logic in placing restraints on the child's hands "than there is in putting adhesive tape across the mouth to cure the baby of hunger."

Dr. Mack said continued thumb-sucking was often an "empty habit" rather than a "meaningful" one.

Pointing out that "thumb-sucking undoubtedly may arise from an emotional need," he said that when a child's emotional difficulties are straightened out, thumb-sucking may cease.

"But there usually appears to be a time lag between these two events," he said. "The time lag is often long enough to permit further indulgence in the habit. This time lag may exist for months or even years. During this period, an 'empty habit' persists."

Notes of Interest

Dr. Irving Grenadier wishes to announce that Dr. Melvin Wallshein is now associated with him in the practice of orthodontics at 888 Grand Concourse, New York, N. Y.

William M. Lathrop, D.D.S., M.S.D., announces the opening of his office at 595 National Reserve Bldg., Topeka, Kan., practice limited to orthodontics.

Albert P. Westfall announces the opening of his new office at 2702 Westheimer Road, Houston 6, Texas, for the continuation of his practice of orthodontics.

The American Board of Orthodontics

Inasmuch as the American Board of Orthodontics during the past year was accredited by the American Dental Association, and for the added reason that this Board now assumes an official role over the destiny of the specialty, there is published herewith the following data pertaining to the Board.

It is thought that this information will be of great interest to the readers of the JOURNAL.—*Ed.*

The American Board of Orthodontics announces that at its meeting held in Louisville, Ky., April 18 to April 22, 1951, certificates were granted to twenty-six orthodontists.

The next meeting of the Board will be held immediately prior to the 1952 session of the American Association of Orthodontists in St. Louis, Mo. Those desiring to be certified may obtain application blanks from the Secretary, C. Edward Martinek, 661 Fisher Bldg., Detroit 2, Mich. Applications must be filed not later than March 1, 1952, for consideration at the St. Louis meeting.

At the Louisville meeting the American Board of Orthodontics included in its minutes the following tribute to Dr. Joseph Eby, retiring President:

> Upon the retirement of its President, Jos. D. Eby, from the American Board of Orthodontics, extending over a period of ten years, his fellow Directors desire to have recorded in the Minutes of the Board, their deep appreciation of his untiring devotion and genuine leadership, and his sincere efforts for the advancement of the specialty.

The Board takes great pleasure in announcing the appointment of Dr. Lowrie J. Porter as new Director of the American Board of Orthodontics.

C. Edward Martinek, Secretary

American Board of Orthodontics

President, Stephen C. Hopkins, . . . 1746 K St., N. W., Washington 6, D. C.
Vice-President, Leuman Waugh, . . . 931 Fifth Ave., New York, N. Y.
Secretary, C. Edward Martinek, . . . 661 Fisher Bldg., Detroit 2, Mich.
Treasurer, Reuben E. Olson, . . . 712 Bitting Bldg., Wichita, Kan.
Director, Raymond L. Webster, . . . 133 Waterman St., Providence, R. I.
Director, Ernest L. Johnson, . . . 450 Sutter St., San Francisco, Calif.
Director, Lowrie J. Porter, . . . 41 East 57th St., New York, N. Y.

Directors of The American Board of Orthodontics From The First Year of Its Corporate Existence

1930-1935	Albert H. Ketcham
1930	Alfred P. Rogers
1930	Lloyd S. Lourie
1930-1938	B. Frank Gray
1930-1932	Martin Dewey
1930-1935	Abram Hoffman
1930-1936	Oren A. Oliver
1930-1937	Albert W. Crosby
1930-1938	Frank M. Casto
1932-1941	Harry B. Kelsey
1935-1942	Chas. R. Baker
1936-1944	Wm. E. Flesher
1936-1949	B. G. deVries
1937-1946	Fred. T. Murlless
1938-1948	Oliver W. White
1939-1950	James D. McCoy
1941-1951	Jos. D. Eby
1942-1946	Claude Wood
1944-1949	James A. Burrill
1946-1952	Stephen C. Hopkins
1946-1954	Reuben E. Olson
1948-1955	Raymond L. Webster
1949-1953	Leuman M. Waugh
1949-1956	C. Edw. Martinek
1950-1957	Ernest L. Johnson
1951-1958	Lowrie J. Porter

Twenty-third Board of Directors
Fiscal Year—1951-1952

	Elected	Term	Expiration Date
Stephen Hopkins, President	1946*	5 years	1952
Leuman Waugh, Vice-President	1949**	4 years	1953
Reuben E. Olson, Treasurer	1946	7 years	1954
Raymond Webster	1948	7 years	1955
C. Edward Martinek	1949	7 years	1956
Ernest L. Johnson	1950	7 years	1957
Lowrie J. Porter	1951	7 years	1958

Twenty-second Board of Directors
Fiscal Year—1950-1951

	Elected	Term	Expiration Date
Jos. D. Eby, President	1941	7 years	1951
Stephen Hopkins, Vice-President	1946*	5 years	1952
Leuman Waugh	1949**	4 years	1953
Reuben E. Olson, Treasurer	1946	7 years	1954
Raymond Webster	1948	7 years	1955
C. Edward Martinek, Secretary	1949	7 years	1956
Ernest L. Johnson	1950	7 years	1957

Twenty-first Board of Directors
Fiscal Year—1949-1950

	Elected	Term	Expiration Date
James D. McCoy, President	1940	7 years	1950
Jos. D. Eby, Vice-President	1941	7 years	1951
Stephen Hopkins, Secretary	1946*	5 years	1952
Leuman Waugh	1949**	4 years	1953
Reuben E. Olson, Treasurer	1946	7 years	1954
Raymond Webster	1948	7 years	1955
C. Edward Martinek	1949	7 years	1956

Twentieth Board of Directors
Fiscal Year—1948-1949

	Elected	Term	Expiration Date
B. G. deVries, President	1939	7 years	1949
James D. McCoy	1940	7 years	1950
Jos. D. Eby, Vice-President	1941	7 years	1951
Stephen Hopkins, Secretary	1946*	5 years	1952
James Burrill, Treasurer	1944	7 years	1953
Reuben E. Olson	1946	7 years	1954
Raymond Webster	1948	7 years	1955

Nineteenth Board of Directors
Fiscal Year—1947-1948

	Elected	Term	Expiration Date
Oliver W. White, President	1938	7 years	1948***
B. G. deVries, Secretary	1939	7 years	1949***
James D. McCoy	1940	7 years	1949
Jos. D. Eby, Vice-President	1941	7 years	1951***
Stephen Hopkins	1946*	5 years	1952***
James Burrill, Treasurer	1944	7 years	1953***
Reuben E. Olson	1946	7 years	1954***

*Filling the unexpired term of Claude Wood.

**Filling the unexpired term of James Burrill.

***Since no meeting was held in 1947 expiration date of all Directors' terms was extended an additional year.

Eighteenth Board of Directors
Fiscal Year—1946-1947

	Elected	Term	Expiration Date
Oliver W. White, President	1938	7 years	1947
B. G. deVries, Secretary	1939	7 years	1948
James D. McCoy	1940	7 years	1949
Jos. D. Eby, Vice-President	1941	7 years	1950
Stephen Hopkins	1946*	5 years	1951
James Burrill, Treasurer	1944	7 years	1952
Reuben E. Olson	1946	7 years	1953

Seventeenth Board of Directors
Fiscal Year—1945-1946

	Elected	Term	Expiration Date
Fred T. Murlless, President	1937	7 years	1946**
Oliver W. White, Treasurer	1938	7 years	1947**
B. G. deVries, Secretary	1939	7 years	1948**
James D. McCoy	1940	7 years	1949**
Jos. D. Eby, Vice-President	1941	7 years	1950**
Claude Wood	1942	7 years	1951**
James Burrill	1944	7 years	1952**

Sixteenth Board of Directors
Fiscal Year—1944-1945

	Elected	Term	Expiration Date
Fred T. Murlless, President	1937	7 years	1945
Oliver W. White, Treasurer	1938	7 years	1946
B. G. deVries, Secretary	1939	7 years	1947
James D. McCoy	1940	7 years	1948
Jos. D. Eby, Vice-President	1941	7 years	1949
Claude Wood	1942	7 years	1950
James Burrill	1944	7 years	1951

Fifteenth Board of Directors
Fiscal Year—1943-1944

	Elected	Term	Expiration Date
Wm. E. Flesher, President	1936	7 years	1944***
Fred T. Murlles, Vice-President	1937	7 years	1945***
Oliver W. White, Treasurer	1938	7 years	1946***
B. G. deVries, Secretary	1939	7 years	1947***
James D. McCoy	1940	7 years	1948***
Jos. D. Eby	1941	7 years	1949***
Claude Wood	1942	7 years	1950***

Fourteenth Board of Directors
Fiscal Year—1942-1943

	Elected	Term	Expiration Date
Wm. E. Flesher, President	1936	7 years	1943
Fred T. Murlless, Vice-President	1937	7 years	1944
Oliver W. White, Treasurer	1938	7 years	1945
B. G. deVries, Secretary	1939	7 years	1946
James D. McCoy	1940	7 years	1947
Jos. D. Eby	1941	7 years	1948
Claude Wood	1942	7 years	1949

*Filling the unexpired term of Claude Wood.

**Because of the War no meeting was held in 1945 and expiration date of all Directors' terms was extended one year.

***Because of the War no meeting was held in 1943 and expiration date of all Directors' terms was extended one year.

Thirteenth Board of Directors
Fiscal Year—1941-1942

	Elected	Term	Expiration Date
Chas. Baker, President	1935	7 years	1942
Wm. E. Flesher	1936	7 years	1943
Fred. T. Murlless, Vice-President	1937	7 years	1944
Oliver W. White, Treasurer	1938	7 years	1945
B. G. deVries, Secretary	1939	7 years	1946
James D. McCoy	1940	7 years	1947
Jos. D. Eby	1941	7 years	1948

Twelfth Board of Directors
Fiscal Year—1940-1941

	Elected	Term	Expiration Date
H. E. Kelsey, President	1934	7 years	1941
Chas. Baker, Secretary	1935	7 years	1942
Wm. E. Flesher	1936	7 years	1943
Fred T. Murlless, Vice-President	1937	7 years	1944
Oliver W. White	1938	7 years	1945
B. G. deVries, Treasurer	1939	7 years	1946
James D. McCoy	1940	7 years	1947

Eleventh Board of Directors
Fiscal Year—1939-1940

	Elected	Term	Expiration Date
James D. McCoy	1939*	1 year	1940
H. E. Kelsey, President	1934	7 years	1941
Chas. Baker, Secretary	1935	7 years	1942
Wm. E. Flesher	1936	7 years	1943
Fred. T. Murlless, Vice-President	1937	7 years	1944
Oliver W. White	1938	7 years	1945
B. G. deVries, Treasurer	1939	7 years	1946

Tenth Board of Directors
Fiscal Year—1938-1939

	Elected	Term	Expiration Date
B. G. deVries, Treasurer	1936**	3 years	1939
Frank Gray, Vice-President	1933	7 years	1940
H. E. Kelsey, President	1934	7 years	1941
Chas. Baker, Secretary	1935	7 years	1942
Wm. E. Flesher	1936	7 years	1943
Fred T. Murlless	1937	7 years	1944
Oliver W. White	1938	7 years	1945

Ninth Board of Directors
Fiscal Year—1937-1938

	Elected	Term	Expiration Date
Frank Casto, President	1931	7 years	1938
B. G. deVries, Treasurer	1936**	3 years	1939
Frank Gray, Vice-President	1933	7 years	1940
H. E. Kelsey	1934	7 years	1941
Chas. Baker, Secretary	1935	7 years	1942
Wm. E. Flesher	1936	7 years	1943
Fred. T. Murlless	1937	7 years	1944

*Filling unexpired term of Frank Gray.
**Filling unexpired term of Albert Ketcham.

Eighth Board of Directors
Fiscal Year—1936-1937

	Elected	Term	Expiration Date
Albert Crosby, President	1930	7 years	1937
Frank Casto	1931	7 years	1938
B. G. deVries, Treasurer	1936*	3 years	1939
Frank Gray, Vice-President	1933	7 years	1940
H. E. Kelsey	1934	7 years	1941
Chas. Baker, Secretary	1935	7 years	1942
Wm. E. Flesher	1936	7 years	1943

Seventh Board of Directors
Fiscal Year—1935-1936

	Elected	Term	Expiration Date
Oren A. Oliver, President	1929	7 years	1936
Albert Crosby, Treasurer	1930	7 years	1937
Frank Casto	1931	7 years	1938
B. G. deVries	1936*	3 years	1939
Frank Gray, Vice-President	1933	7 years	1940
H. E. Kelsey	1934	7 years	1941
Chas. Baker, Secretary	1935	7 years	1942

Sixth Board of Directors
Fiscal Year—1934-1935

	Elected	Term	Expiration Date
Abram Hoffman, Treasurer	1929	6 years	1935
Oren A. Oliver, Secretary	1929	7 years	1936
Albert Crosby	1930	7 years	1937
Frank Casto	1931	7 years	1938
Albert Ketcham, President	1932	7 years	1939
Frank Gray, Vice-President	1933	7 years	1940
H. E. Kelsey	1934	7 years	1941

Fifth Board of Directors
Fiscal Year—1933-1934

	Elected	Term	Expiration Date
H. E. Kelsey	1932**	2 years	1934
Abram Hoffman, Treasurer	1929	6 years	1935
Oren A. Oliver, Secretary	1929	7 years	1936
Albert Crosby	1930	7 years	1937
Frank Casto	1931	7 years	1938
Albert Ketcham, President	1932	7 years	1939
Frank Gray, Vice-President	1933	7 years	1940

Fourth Board of Directors
Fiscal Year—1932-1933

	Elected	Term	Expiration Date
Frank Gray, Vice-President	1929	4 years	1933
H. E. Kelsey	1932**	2 years	1934
Abram Hoffman, Treasurer	1929	6 years	1935
Oren A. Oliver, Secretary	1929	7 years	1936
Albert Crosby	1930	7 years	1937
Frank Casto	1931	7 years	1938
Albert Ketcham, President	1932	7 years	1939

*Filling unexpired term of Albert Ketcham.
**Filling unexpired term of Martin Dewey.

Third Board of Directors
Fiscal Year—1931-1932

	Elected	Term	Expiration Date
Albert H. Ketcham, President	1931*	1 year	1932
Frank Gray, Vice-President	1929	4 years	1933
Martin Dewey	1929	5 years	1934
Abram Hoffman, Treasurer	1929	6 years	1935
Oren A. Oliver, Secretary	1929	7 years	1936
Albert Crosby	1930	7 years	1937
Frank Casto	1931	7 years	1938

Second Board of Directors
Fiscal Year—1930-1931

	Elected	Term	Expiration Date
Albert H. Ketcham, President	1930**	1 year	1931
Frank Casto	1930*	2 years	1932
Frank Gray, Vice-President	1929	4 years	1933
Martin Dewey	1929	5 years	1934
Abram Hoffman, Treasurer	1929	6 years	1935
Oren A. Oliver, Secretary	1929	7 years	1936
Albert Crosby	1930	7 years	1937

Directors
Fiscal Year—1929-1930

	Elected	Term	Expiration Date
Albert H. Ketcham, President	1929	1 year	1930
Alfred P. Rogers, Vice-President	1929	2 years	1931
Lloyd S. Lourie, Treasurer	1929	3 years	1932
B. Frank Gray, Secretary	1929	4 years	1933
Martin Dewey	1929	5 years	1934
Abram Hoffman	1929	6 years	1935
Oren A. Oliver	1929	7 years	1936

This Board became the official Directors Jan. 23, 1930.
*Filling unexpired term of Lloyd Lourie, previously assigned to Frank Casto.
**Filling unexpired term of Alfred Rogers.

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